

THE PHILIPPINE AGRICULTURIST

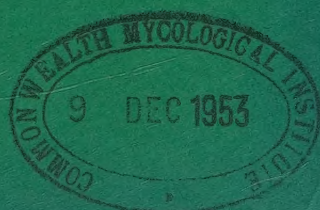
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A REVIEW OF FERTILIZER INVESTIGATIONS ON RICE IN THE COLLEGE OF AGRICULTURE AT LOS BAÑOS¹

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AND JOSÉ R. VELASCO²

The application of fertilizers to increase the yield of rice has recently attracted the attention of Filipino rice growers. It is significant that studies on rice fertilization have been made in the College of Agriculture as early as its founding in 1909.

POT-CULTURE TESTS

Zamora (1911) called attention to the remarkable capacity of ammonium nitrate for increasing rice yield. He found it far superior to either K_2HPO_4 or $MgSO_4$. Roxas (1911) studied the stimulating effects of such compounds as borax, corrosive sublimate, and sulfates of aluminum, copper, iron, manganese, nickel, and zinc and reported that most of these substances had slight stimulating effects in very small amounts but were distinctly toxic at high concentrations. For example, M/2000 copper sulfate added to pot cultures stimulated the growth of rice plants, whereas M/1000 of this salt inhibited growth. This work may be considered the forerunner of microelement studies in the College.

Balangue (1916) found that horse manure at the rate of 250 to 350 petroleum boxes to the hectare was very favorable both to upland and lowland rice. In addition he found that lime increased rice yield, especially in "old" fields. He recommended a fertilizer mixture of 100 kilos of double superphosphate, 100 to 200 petroleum boxes of horse manure, and 100 to 200 petroleum boxes of ashes to the hectare.

Goco (1918) compared the performance of several varieties of rice and, incidentally, studied the influence of certain fertilizers. He noted that ammonium sulfate hastened the growth of young rice plants. A combination of ammonium sulfate, potassium chloride, and double superphosphate, or horse manure, ash, and double superphosphate promoted the growth of rice at the later stages of development. Goco was the first to use ammonium sulfate on rice locally.

Trelease (1920a), Trelease and Jurado (1920b), and Trelease and Paulino (1920c) looked into the efficacy of ammonium sulfate as a fertilizer for rice. Trelease and Jurado (1920b) found that the yield was positively correlated with the amount of ammonium sulfate added to the soil, but had no relation to the applied monocalcium

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² The College of Agriculture Rice Committee appointed by the Dean.

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phosphate or potassium sulfate. Trelease and Paulino (1920c) found that of the nitrogenous salts, ammonium sulfate was the most effective, followed in the descending order by ammonium nitrate, calcium nitrate, and sodium nitrate. Abrajano (1923) cautioned, however, that ammonium sulfate may be harmful if applied to cogon soil. For this kind of soil he recommended dried blood. Vibar (1926) also pointed out that dried blood was more effective than ammonium sulfate. This author added that kainit (a natural mixture of potassium chloride, magnesium chloride, and sodium chloride) was not only ineffective but also toxic to rice; that superphosphate increased yield only slightly; that lime was beneficial to lowland but harmful to upland rice; and that sodium nitrate was toxic to lowland but beneficial to upland rice.

Inasmuch as ammonium sulfate was more readily available in the market than dried blood, it was used in more experiments by subsequent workers. Libatique (1931) used on Ramai increasing amounts of ammonium sulfate and found that 5.43 grams for each kerosene can of soil tended to promote growth and development of the roots; larger amounts retarded root development. Libatique further observed that the fertilized plants produced more though shorter roots than the unfertilized ones, but that there was no apparent difference in anatomical structure and in shoot-root ratio.

Soriano (1934) noted that an increase in the amount of ammonium sulfate was followed by a gradual but steady increase in the percentage of chlorophyll in the leaves, which lasted about one week after the application of the fertilizer. Neither the dry matter nor the moisture content of the leaves was consistently influenced by the fertilizer.

Macasaet (1936) grew Inintiw in kerosene cans containing 19 kilograms of tuff soil and found that the best yield resulted from an application to each can of 4.14 grams of ammonium sulfate containing 27.59 grams of nitrogen, 91.20 grams of phosphoric acid (P_2O_5), and 95.00 grams of potash. No phosphorus or potassium was applied to this soil. Macasaet observed that the addition of superphosphate to this soil was harmful to the rice and that when superphosphate was added with ammonium sulfate, the yield was less than when only ammonium sulfate was added. The addition of potassium sulfate was not found necessary.

In Almeda's (1937) experiment the optimum rate of application of ammonium sulfate was 4.71 grams to each can of 7 kilograms of soil.

Enrile (1938) determined whether or not potassium sulfate should be added with ammonium sulfate to Lipa clay loam, and Talamisan (1938) made a similar determination with superphosphate and ammonium sulfate. In both experiments ammonium sulfate applied singly gave the best results, as was later verified by Topacio (1938) and Cabotage (1941).

Lopez (1939) studied the relation of the amount of fertilizer to the moisture content of the soil at the wilting point of rice and found that, for the most part, there was no relation between the amount of ammonium sulfate applied and the amount of soil moisture at wilting time. In his work Lopez verified an earlier observation by Serrano (1938) that as the plants grew older, more and more moisture was left in the soil at the time of wilting.

Espino and Crocker (1940) reported that in the fertilization of rice with ammonium sulfate, the nitrogen in the leaves increased from 1.32 per cent in the unfertilized plants to 3.18 per cent in the fertilized plants. As to size of grains, Juliano and Ramos (1940) noted that the kernels of the fertilized lot were larger than those of the unfertilized lot. The weight of the panicles in the fertilized lot was also higher than that in the control.

Espino and Agda (1941) considered the value of Mayon volcano ash to rice and found that 800 grams or more of the ash was decidedly harmful; the harmful effect, however, could be counteracted by ammonium sulfate application. Galvez and Agbagala (1949) applied copra meal on Nanhaya clay loam and concluded that the best rate was 50 grams of copra meal for every 5 kilograms of soil. This rate of application increased the yield, the size of the grains, and the mineral and nitrogen contents of the milled grains.

WATER-CULTURE EXPERIMENTS

The first local attempt to grow rice plants in culture solution was by Villegas (1912) who grew rice in water extracts of cogon soil and bamboo soil and found that the crop was much retarded in growth. Villegas noted, however, that when the cogon or bamboo soil was first fertilized with NaNO_3 before leaching, the extract stimulated the growth of rice plants. From these observations Villegas concluded that the extracts from cogon soil and bamboo soil contained certain toxic substances.

Espino (1922) worked on the mineral requirement of rice and found that the plants could grow normally up to 45 days of age in a culture solution containing 4 parts (by moles) of MgSO_4 , 1.5 parts of $(\text{NH}_4)_2\text{SO}_4$, 1.5 parts of $\text{Ca}(\text{NO}_3)_2$, and 1 part of KH_2PO_4 . This solution has an aggregate molarity of 0.002. One of this author's observations was that young rice plants could not grow normally without a supply of ammonium salts in the culture solution. This observation was later verified by Espino and Estioko (1931) who noted that the plants which derived nitrogen solely from an applied nitrate source were stunted and chlorotic, suggesting nitrogen deficiency. Furthermore, the plants which were grown in solutions where only ammonium salts were present showed drying at the leaf tips.

Gines (1930) worked with different salts of iron and observed that $\text{Fe}(\text{NO}_3)_3$, $\text{FeNH}_4(\text{SO}_4)_2$, and FeSO_4 in complete culture solu-

tions tended to produce slender young rice plants. The range of effective concentration of FeCl_3 and $\text{Fe}(\text{NO}_3)_3$ was 13.3 to 133.4 ppm. The more soluble salts of iron were needed in small amounts, but when given in excess became rather harmful.

Macasaet (1932) evaluated the influence of single salts on young rice plants in 0.001, 0.002, and 0.004 molar solutions of nitrates, sulfates, phosphates, chlorides, and carbonates of ammonium, potassium, calcium, and magnesium. Among the nitrates, KNO_3 and $\text{Mg}(\text{NO}_3)_2$ were most harmful, though NH_4NO_3 and $\text{Ca}(\text{NO}_3)_2$ seemed beneficial. In general the sulfates were not toxic; the best of them was K_2SO_4 . Of the phosphates, KH_2PO_4 was the best and $\text{Ca}(\text{H}_2\text{PO}_4)_2$ the most harmful. Ammonium chloride was the best of the chlorides, but with the possible exception of CaCO_3 , all the carbonates were harmful.

Hsieh (1941) searched for a good culture solution for rice plants over 45 days of age and formulated a 0.002 molar solution consisting of 1 part by mole of KH_2PO_4 , 1 part $(\text{NH}_4)_2\text{SO}_4$, 1 part $\text{Ca}(\text{NO}_3)_2$, and 5 parts MgSO_4 . The best pH range was 6.52 to 7.04.

STUDIES ON STIMULANTS AND INFLUENCE OF WEEDS

Roxas (1911) worked on stimulants on rice, followed by Jimenez (1924) who held that manganese sulfate and chloride were beneficial to the growth and yield of rice in pot culture. The optimum rate varied with the compound; MnCl_2 at the rate of 0.22 per cent by weight of the soil decreased the yield, whereas MnO_2 was optimum at 0.22 to 1.10 per cent. Jimenez further stated that lime seemed to counteract the beneficial effect of manganese.

Villegas' (1912) preliminary observation on the deleterious effect of cogan soil extract on rice was followed by the study by Peralta and Estioko (1923) of the influence of root excretion of common paddy weeds upon the yield of lowland rice. The two writers found that *Cyperus* spp. and *Monochoria hastata* (L.) Solm. excreted substances that were beneficial to rice. However, zacate, *Leersia hexandra* Sw., and rice itself excreted substances that were harmful to rice. In a later paper Peralta (1931) reported that rice weeds turned under and allowed to decay before the rice was planted increased the yield considerably. Weeds growing in the field, however, are harmful to the rice crop (Cabailo, 1925) because they compete with it for soil nutrients and space.

PLOT EXPERIMENTS

Studies on the application of fertilizers in lowland and upland rice fields were conducted in the College of Agriculture from 1933 to 1941. Different brands of fertilizers were tried and, except with the home-mixed fertilizers, four rates of application; namely, 50, 100, 150, and 200 kilograms to the hectare. In the lowland rice fields the fertilizers were applied two weeks after transplanting (Rivera, 1936). The paddies were drained to 6 to 10 centimeters

of water and the fertilizers broadcast evenly. In upland fields the same rates were tried, but the fertilizers were mixed with the grains before broadcasting. Table 1 gives the results of these fertilization studies, from which the following general deductions can be made:

1. The optimum rate of application regardless of the brand or N-P-K content of the fertilizers is 100 to 150 kilograms to the hectare.

2. The lowland rice fields of the College of Agriculture need three elements; namely, nitrogen, phosphorus, and potassium.

3. Increases in yield ranging from 14.28 to 91.95 per cent are possible.

Calma and Rico (1948) showed that fertilizers applied without the needed supply of water to control the weeds were detrimental to the rice crop.

Azares (1952) determined the influence of ammonium sulfate alone and in combination with varying amounts of superphosphate on the yield of Wagwag rice and concluded that the optimum combination should consist of 100 kilograms of ammonium sulfate and 50 kilograms of superphosphate. Applied at this rate, the fertilizers produced an increase of 34.09 per cent a hectare over the unfertilized control. Of four treatments, the plants which received the minimum amount of superphosphate gave the highest yield to a hectare, indicating that the best results are obtained from the application of not more than 50 kilograms to a hectare.

RICE SOILS STUDIES

The first work on the reactions occurring in the soil was made by Panganiban (1923) who found that during the dry season when the rice paddies were lying fallow, the decomposition of organic matter was slow (as measured by CO_2 evolution), but the accumulation of ammonia was large. There was active evolution of CO_2 after heavy rains, and nitrification proceeded more rapidly with the conversion of ammonia to nitrates.

Ureta (1925) became interested in what happens to phosphates during cropping and found that growing two crops of rice caused a reduction of 6.22 per cent of the total P_2O_5 in the soil. When phosphatic fertilizer was added to the soil, 51.8 per cent of the amount added was lost. The amount removed by the rice crops was less than 2 per cent so that about 50 per cent must have been lost through leaching. Ureta also marked a gradual conversion of the more readily soluble form of phosphorus to the less readily soluble form.

Galvez and Subido (1941) found that the percentage of inorganic constituents increased with the age of the rice plants, whereas the percentage of K_2O , CaO , and MgO in the ash gradually decreased. These authors deduced that cations belonging to the nonessential elements were absorbed by the rice plant in the later stages of its life. They also noted that the decrease in the amount of K_2O ab-

sorbed from the soil by rice plants was more abrupt than that of CaO or MgO.

Toh and Galvez (1947) studied the absorption by rice plants of phosphorus and potassium and found that the maximum absorption of the root soluble P_2O_5 by rice seedlings was at the age of 18 to 22 days and that of root soluble K_2O , at the age of 16 to 20 days.

Since root solubility of any element is dependent in part on pH, Rola and Galvez (1949) grew rice plants in pot cultures where the soil reaction ranged from 5.3 to 7.5, analyzed the rice grains for nitrogen, phosphorus, and iron, and found that nitrogen did not vary with pH, whereas phosphorus and iron were highest in cultures with pH values of 5.3 to 6.2.

EVALUATION OF THE RESULTS PRESENTED AND RECOMMENDATION

Certain points have been fairly well established by the studies reviewed. The results have established that Lipa clay loam, the soil most readily available in the upland fields of the College of Agriculture, does not need the addition of phosphorus and potassium in order to produce a good crop of rice. All that this soil needs is an occasional application of ammonium sulfate, the amount depending upon the cost of the fertilizer and the price that the yield increment will bring in. The fertilizer has effects other than increased yield. It increases tillering and promotes the general vigor of the plants. Certain fundamental principles on the nutrition of rice have been studied in artificial media and some factors of the soil complex have been investigated.

A number of defects are apparent in the investigations, but considering the facilities available to the investigators, it is surprising how much has been accomplished at very little expense.

One defect of the experiments under field conditions is that the tests on the comparative fertilizing values of nitrogen, phosphorus, and potassium were carried out at different times; hence, the results cannot be justly compared. Although the defect cannot now be corrected, the data show the approximate amounts of the fertilizers suitable for application in our fields.

No attempt has been made to determine the residual effects of the fertilizers or the cumulative effects of a continuous application of a certain fertilizer. The use of amendments like lime and sulfur has received only passing notice. In most of the field experiments, *Elon-elon* and *Ramai*, a medium-late and a late maturing variety, respectively, were used as the test plants. The results obtained with these varieties can scarcely be interpreted in terms of the performance of the early varieties or of the bearded and glutinous varieties.

There are phases of the problem that need further study. A few of them have to do with (1) the nature of the functions of each element in plant nutrition; (2) the mechanism of the uptake of nutrients by plants; (3) the forms of the available and non-available

nutrients in the soil; (4) a more detailed picture of plant-soil relationship; and (5) the influence of fertilization on the quality of the rice grain. Concepts have to be formulated and new techniques devised which will pave the way to new approaches to the problem of fertilization.

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TABLE 1
Results of fertilizer tests on rice for many years in the College of Agriculture

INVESTIGATOR AND YEAR	BEST YIELD <i>cavans</i>	BEST AMOUNT OF N-P-K APPLIED TO A HECTARE <i>kg.</i>	VARIETY USED	BRAND AND COMPOSITION OF FERTILIZER	BEST RATE OF APPLI- CATION TO A HEC- TARE ¹ <i>kg.</i>	INCREASE IN YIELD TO A HECTARE OWING TO FERTILIZER		VALUE OF IN- CREASE IN YIELD OF A HEC- TARE ² <i>pesos</i>	TOTAL FERTI- LIZER AND APPLI- CATION <i>pesos</i>	GAIN A HECTARE FROM FERTI- LIZER ³ <i>pesos</i>
						<i>cavans</i>	<i>per cent</i>			
Benitez, A. D. (1933) ^b	74.78	19.5-9.3	Ramai	Hoz	150	14.03	23.19	35.20	17.50	17.70
Serquenla, A. (1934) ^b	107.81	19.5-9.3	Elon-elon	13-6-2	150	51.65	91.95	129.12	13.57	105.55
Roque, S. R. (1933) ^a	85.88	15.0-9.3	Ramai	Corona No. 1	150	20.11	26.33	50.27	14.82	35.45
Ocampo, E. S. (1934) ^a	85.60	15.0-9.3	Elon-elon	10-6-2	150	29.45	52.44	73.62	12.87	60.75
Pamintuan, M. S. (1933) ^b	89.81	13.5-13.5-6	Ramai	Corona Arroz	150	21.44	31.37	53.60	15.28	38.32
Asuncion, V. (1934) ^a	80.60	13.5-13.5-6	Elon-elon	9-9-4	150	18.77	23.26	46.92	12.00	34.92
Briones, F. B. (1934) ^a	83.30	7.5-12-15	Ramai	Corona Especial	150	23.08	23.90	57.70	13.35	44.35
Sarikabhuti P. (1935) ^a	90.67	10.0-16-20	Elon-elon	5-8-10	200	21.79	30.63	54.44	18.26	36.21
Abelardo, M. R. (1936)	100.81	22.5-22.5-27	Ramai	Nirophoska IG No. 4	150	23.85	23.65	59.32	27.15	32.48
Lopez, L. (1936) ^a	97.85	22.5-22.5-27	Elon-elon	15-15-18	150	23.58	26.14	63.91	19.19	44.76
Garcia, S. (1936) ^b	67.30	21-17.55-39	Ramai	Nirophoska IG No. 2	150	24.30	54.00	66.83	27.64	39.19
Galapon, (1936) ^a	49.62	14-11.7-26	Elon-elon	14-11.7-26	100	6.85	17.43	17.18	17.93	0.80
Garzon, D. P. (1935) ^b	85.29	11.33-3.05-1.67	Ramai	Bat guano	150	15.14	17.75	37.85	5.52	32.33
Alberto, A. (1936) ^a	101.88	1.27-8.8-0.34	Elon-elon	Bat guano 7.55-2.03-1.11						
Butac, F. (1933) ^b	89.45	20.6-0-0	Ramai	Ammonium sulfate	150	25.00	24.53	62.50	4.19	58.31
Flores (1934) ^a	73.93	20.6-0-0	Elon-elon	20.6-0-0	100	18.58	26.22	45.62	8.50	37.95
Villanueva (1933) ^a	89.47	20.20-0	Ramai	Ammo-Phos	100	14.90	25.40	33.25	7.75	29.50
Antonio, V. (1934) ^b	98.65	30-30-0	Elon-elon	20-20-0	150	34.86	54.66	87.15	18.45	68.70
Castillo, A. (1934) ^a	65.47	0-27-30-0	Ramai	Superphosphate	150	12.00	22.44	30.00	8.14	21.86
Dionido, P. B. (1937) ^a	56.34	0-28.50-0	Elon-elon	0-(18-20)-0	150	9.96	21.47	24.90	8.49	16.41

¹ Except with home-mixed fertilizers, rates of application were 50, 100, 150, and 200 kg. to a hectare.

² One cavan of 44 kg. of palay cost ₱2.50.

³ The gain was computed by subtracting the cost of fertilizer and its application from the value of the increase in yield.

⁴ Carreon is an upland rice variety.

^a Unpublished thesis.

^b Thesis published in Biweekly Bulletin.

TABLE 1 (continued)

INVESTIGATOR AND YEAR	BEST YIELD	BEST AMOUNT OF N-P-K APPLIED TO A HECTARE	VARIETY USED	BRAND AND COMPOSITION OF FERTILIZER	BEST RATE OF APPLICATION TO A HECTARE ¹	INCREASE IN YIELD TO A HECTARE OWING TO FERTILIZER		VALUE OF INCREASE IN YIELD OF A HECTARE ²	TOTAL COST OF FERTILIZER AND APPLICATION	GAIN A HECTARE FROM FERTILIZER ³
						cavans	per cent			
	cavans	kg.			kg.			pesos	pesos	pesos
Petrasanta, S. (1938) ^b	76.66	11.25-30.0	Ramai	Non-Plus-Ultra	150	22.84	42.86	57.10	19.95	37.15
Briones, T. (1936) ^b	64.35	33-40.0	Elon-elon	16.5-20.0	200	16.34	34.03	40.85	24.23	16.62
Romakin, F. M. (1939) ^b	66.80	0-0-72.75	Ramai	Sulfate of potash	150	32.29	48.34	80.72	22.20	58.52
Perez, I. B. (1936) ^a	43.39	0-0-72.75	Elon-elon	0-0-(48.50)	150	12.48	40.37	31.20	23.25	7.95
Asuncion, A. (1934) ^a	68.50		Ramai	Home-mixed super-phosphate	200	9.78	14.28	24.45	17.63	6.77
				0-(18-20)-0	40					
Macabandong, R. (1936) ^a	88.05	0-38-19.6	Elon-elon	Sulfate of potash	200	14.42	19.17	36.05	16.62	19.43
				0-0-(48-50)	40					
Fontanilla, A. (1934) ^b	56.11	20.6-0-9.8	Ramai	Ammonium sulfate	100	9.18	19.56	12.95	11.13	11.82
				20.6-0-0	20					
Juan, V. (1935) ^b	85.18	20.6-0-9.8	Elon-elon	Sulfate of potash	100	15.18	21.47	37.65	12.14	25.51
				0-0-(48-50)	20					
Reyes, F. (1935) ^b	93.06	41.2-7.6-0	Ramai	Ammonium sulfate	200	15.41	16.77	35.52	17.60	20.92
				20.6-0-0	40					
Salcedo, F. (1936) ^b	93.06	41.2-7.6-0	Elon-elon	Superphosphate	200	22.31	31.50	55.77	19.26	36.51
				0-(18-20)-0	40					
Miranda, M. C. (1938) ^b	45.76	22-22-27	Ramai	Ammonium sulfate	106.5					
				20.6-0-0	116.0	11.48	33.48	28.70	7.10	21.60
				Superphosphate	56.0					
				0-(18-20)-0	106.5					
Gabriel, E. P. (1940) ^b	45.64	22-22-27	Elon-elon	Sulfate of potash	116.0	13.45	29.26	33.62	7.10	26.52
				0-0-(48-50)	56.0					
Ariaga, J. A. (1941) ^b	63.94	13-6-2	Carreon ⁴	Hoz	100	19.24	30.09	48.10	20.90	27.20

¹ Except with home-mixed fertilizers, rates of application were 50, 100, 150, and 200 kg. to a hectare.² One cavans of 44 kg. of palay cost ₱2.50.³ The gain was computed by subtracting the cost of fertilizer and its application from the value of the increase in yield.⁴ Carreon is an upland rice variety.^a Unpublished thesis.^b Thesis published in Biweekly Bulletin.

THAILAND: III. FARMING ¹

F. M. FRONDA ²

WITH FIVE TEXT FIGURES

A Filipino farmer traveling in Thailand is impressed by the similarity of the country's landscape to that of the Philippines (fig. 1, left). The farmhouses, the surroundings, and the roadsides are practically the same as those of this country. In Central Thailand, however, the landscape is crisscrossed by canals and irrigation ditches (fig. 1, right). These canals are a typical sight in this region. They serve the farmer as a source of water for irrigation and for domestic use, as well as an excellent avenue of transportation for his family and for the products of his farm.



Fig. 1.—Left—Different varieties of lotus that add color to the countrysides of Thailand. Right—The irrigation canals which also give good harvests of fish for the farmer's family.

Life on the farm. Outwardly, the farmer of Thailand is very much like his Filipino counterpart. Both use the same kind of animal and essentially the same tools in the cultivation of their farms. They employ practically the same farming methods and grow almost the same crops. Both farmers may own a pig or two and a flock of either chickens or ducks. Their homes may even have the same stack of rice straw that constitutes the main diet of their work animals during the dry months.

Upon closer observation, however, a significant difference between the home life of the Thai farmer and that of the Filipino farmer becomes apparent. As most of the farmers of Thailand, about 80 per cent or more, own the land that they cultivate, they appear

¹ General Contribution No. 858.

² Poultry Production Expert (Thailand, 1951-1952) of the Food and Agriculture Organization of the United Nations.

to be happier and more contented than our farmers in the Philippines. They are not heavily in debt and they seem to prefer to go along in a small way rather than increase their holdings or the production of their farms by borrowing money at high rates of interest. Moreover, the Thai farmer can make a living on much less work a year than the farmers in other countries of the world. Since there are no destructive typhoons in Thailand, the crops are safe from these devastating elements. In some places, the abundance of water in the canals the year round makes continuous production possible and, hence, the farmer always has something to do.

Like the Filipino farmer, however, the farmer in Thailand also encounters a number of problems. His work animals may be killed any time by rinderpest. His pigs and his flock of either chickens or ducks may be entirely wiped out by disease. His rice may be attacked by field pests as well as storage pests. The Thai farmer, however, cannot complain because the government is doing all it can to help him. His welfare is the chief concern of the government officials from the highest to the lowest.

Rice production. The production of rice both for local consumption and for export has been the main industry of the people of Thailand for many years. That perhaps about ninety per cent of the cultivated land in the country is devoted to the production of rice alone is a conservative estimate. Indeed, the country has been self-sufficient in rice for a long time and rice has been Thailand's leading export since the end of World War I. At present most of the rice-eating countries of the world depend upon Thailand to supplement their rice supply.

The principal rice-growing area in Thailand is the central region. This entire region is low and flat and the soil is deep and heavy clay. It is flooded every year, the flood water in some areas becoming as deep as 3 to 4 meters. The bulk of the rice for export is grown in this region. The other regions of Thailand, however, the North, Northeast, and South, also produce rice, mostly for local consumption. In these places, the rice lands are generally located along the rivers and, in the South, also in the coastal plains.

The growing of rice in Thailand is by no means limited to these areas alone. Rice is also grown in *caiñgins* by the hill tribes and by people who live near the forests. The *caiñgin* system in Thailand, known as the dryland rice cultivation, does not differ from our own *caiñgin* system in the Philippines. The big trees and the underbrush are cut in the early part of the dry season and are burned to ashes when they have thoroughly dried. The cleared area is then planted. After several seasons, the place is abandoned and a new one is cleared. As in the Philippines, this system offers a great problem in Thailand since it destroys the forests on the hillsides and thus increases soil erosion.

Two types of rice are grown extensively in Thailand, the glutinous and the non-glutinous. In the North and Northeast, where the

people prefer the glutinous rice in their daily diet, more of the glutinous type than the non-glutinous is grown; in Central and South Thailand, the bulk of the rice grown is the non-glutinous type. In Central Thailand, two kinds of non-glutinous rice are grown, the floating rice and the ordinary rice. Floating rice varieties are grown in the deeply flooded areas, and ordinary rice, in the areas where the flood water is not deep.



Fig. 2.—Upper panel—Harrowing. Lower panel—Transplanting the rice seedlings. *Photograph by courtesy of the Department of Agriculture, Thailand.*

The Thai rice farmer uses two methods of lowland rice cultivation, the transplanting and broadcasting methods. The transplanting method as practiced in Thailand does not differ very much from that practiced in the Philippines. The field is plowed when it is soft enough for plowing. When sufficient water is in the field, it is plowed again, harrowed, (fig. 2, upper panel) and puddled before transplanting (fig. 2, lower panel). After transplanting, the field is kept well supplied with water, and the Thai farmer nurses his young rice plants in much the same way as the Filipino farmer does.

In the preparation of the seedbed, however, a little difference may be noted. The seedbed is generally located near a good source of water so that the seedlings can be taken care of properly. The seeds are sown about a month before the plants are expected to be

transplanted. The seeds are first sprouted before they are broadcast in the seedbed that has been previously puddled, drained of water, and left for a few hours to settle down. It is necessary that the bed be allowed to settle so that the sprouted seeds will not sink too deep into the mud and can be uprooted easily for transplanting. The seedbed is then allowed to dry for about a week and then watered little by little. To keep the rice seedlings from growing too tall, as little water as possible is allowed in the seedbed. When the seedlings are ready to be transplanted, they are pulled out, cleaned of mud, separated into individual plants, and bundled.

The transplanting method cannot be used in areas where the flood water becomes deep because transplanted rice cannot keep pace with the abrupt rise in level of the flood water. Also, the floating rice varieties cannot be transplanted because they have very strong, extensive root systems and the bases of their stems are very brittle and would easily break if the plants were pulled for transplanting. For these reasons, the broadcasting method of rice cultivation is always employed in deeply flooded areas. It is, however, the transplanting method that is used more extensively in the rice-producing areas of Thailand.

Of the broadcasting method of rice cultivation, there are variations to suit particular conditions. In general, the method may consist of either of two variations. In the first, the field is plowed as early as possible and left untouched till about the time of sowing. The seeds are broadcast and then covered immediately by a second plowing to protect them against rats and birds. The farmers claim that with this plowing the young plants obtain a good hold on the soil and are protected from winds and the hot sun. They also say that the crop becomes strong enough to resist drought and does not lodge easily before harvest. The success of this system is highly dependent upon the rainfall. If it rains hard soon after the second plowing, the clods may break down completely and bury the seeds too deep into the ground. If, on the other hand, it does not rain within three weeks after the second plowing, the seeds may deteriorate under the clods and a reseedling may become necessary. In reseedling, the seeds are left uncovered on top of the clods.

In the other variation of the broadcasting method, the seeds are sown in the field where the standing water is one-half to three-quarters of a meter deep. The field is plowed first, then harrowed to remove the weeds. The water in the field is then left to settle until it is clear. In the meantime, the seeds are sprouted and then broadcast over the field. It is essential that the water be clear when the sprouted seeds are broadcast; otherwise, the mud will cover the young shoots and prevent them from growing above the level of the water.

In harvesting rice, the panicles are cut and tied into bundles (fig. 3, upper panel). Threshing is done by beating the bundles either against the side of a large bamboo basket or against the thresh-

ing floor. In Central Thailand, the rice bundles are laid down on the threshing floor and trampled on by carabaos or cattle (fig. 3, lower panel). In this way, the grains are separated from the straw with little human effort. Obviously, then, the farmers prefer to plant varieties of rice that shatter easily.



Fig. 3.—Upper panel—Harvesting. Lower panel—Threshing. Photograph by courtesy of the Department of Agriculture, Thailand.

The excellent reputation that Thailand rice enjoys in the world market is due to the care that the farmers exercise in the selection and preservation of the seed and the attention that they give to cultivation. At the outset, the government gathered different rice varieties from all over the country and compared the quality of the grains. From these varieties, the variety locally known as *Pin Kaeow* was selected as having the most perfect type of grain. Since then, the varieties grown by the farmers must have grains whose size, shape, and quality are similar to those of *Pin Kaeow*. The Rangsit Experiment Station, established in 1916, has carried on extensive rice selection, and pure strains of rice have been produced. The country now has for distribution to the farmers a number of selected varieties that differ in date of maturity. The variation in the date of maturity was considered in the selection work so that the period of harvesting would be prolonged, thus helping prevent the possible shortage of labor during the harvesting season.

Mechanized farming. The mechanization of rice production was tried in Thailand years ago, but up to the present, the Thai people

are still trying to solve the major problems that they encountered in the operation of farm machinery in their country. The bulk of transplanted rice produced in Thailand is grown in small fields of about one hectare or even less, owned and operated by the farmers themselves. Obviously, it would not be practical to use tractors under these conditions. Broadcast rice is planted in fields of about ten hectares, but even with the bigger area, a farmer still cannot profitably own and operate a tractor. Nevertheless, the government is trying to see if farmers can use tractors for custom plowing and still operate their farms economically. The average Thai farmer, however, frowns upon the idea of having to pay cash for the plowing of his field, for it would increase his financial investment. When he does his own plowing with his own water buffalo, he will be that much ahead in cash. Consequently, he is happier because he sees that his labor income will be bigger than if he had to pay cash to have his field plowed by a tractor.

Over twenty years ago, the government conducted an experiment on a farm of about three hundred hectares to determine the cost of rice production with farm machinery. It was found that water buffaloes could not be done away with altogether, since it was more economical to plow out corners, cart, and do odd jobs about a fairly large farm with them than with a large tractor. In this experiment, although the rice plants did not lodge, only part of the crop could be harvested with a binder, since it rained heavily during the harvest in January, causing the plants to lie flat on the ground. Thus, they had to be harvested by manual labor.

In growing transplanted rice, more labor is used in transplanting than in harvesting the crop. Harvesting, therefore, is not a problem at all. In growing broadcast rice, however, a bigger area can be planted with less labor. When the time to harvest the crop comes, securing sufficient labor becomes a big problem. Rice is a crop that cannot be left too long in the field after it has become mature enough to be harvested. Even if wider areas could be plowed and planted by broadcasting, the use of tractors in custom plowing would not be practical since there would not be enough labor available to harvest the broadcast crop.

A binder, or even a combine, may be used successfully in harvesting rice only when the plants do not lodge. A solution to the problem of rice lodging should be found if the rice production of Thailand is to be successfully mechanized. It has been shown that the rice plants will not lodge very badly if the water in the rice paddies is kept down to a low level, but this is difficult to do in the principal rice-growing area in Thailand since there is no place where the water may be diverted. Of course, there may be other solutions to this problem, but until they are known, the mechanization of rice production in Thailand will remain limited.

A renewed interest, however, is now being shown by the government in the use of machinery in the production of rice. As a result of World War II and the losses caused by rinderpest, the supply of work animals to cultivate the farms is still far too small to meet the demand. The price of rice is now much higher than before, and the rice producers are being encouraged to increase their production of this essential commodity. It is apparent that Thailand has already reached the limit of her capacity to produce rice unless new areas are opened up to increase the acreage devoted to rice cultivation. All of these provide sufficient incentive for the people to show renewed interest in the mechanization of rice production in Thailand.

Fertilizers in rice production. The rice farmers of Thailand have not yet felt the need for using fertilizers to increase production. The principal rice-growing region becomes flooded every year and the flood water carries with it sufficient fertility to maintain the productive capacity of the land. The government, however, is conducting extensive trials on the use of fertilizers, particularly in areas that are not reached by flood waters.

In the North, the farmers rotate their rice with other crops, like vegetables, peanuts, and tobacco. In some instances, the seedbeds are fertilized in order to hasten the growth of the seedlings. The people in the other regions, however, still hesitate to use fertilizers on their farms, in spite of the great need to increase the production of rice. These farmers would have to buy fertilizer which is imported because the country does not produce it. This means an additional investment for them and because the price of rice is government-controlled, their returns would not be sufficiently high to induce them to use fertilizers. Perhaps a time may come when the results of the extensive rice fertilization trials now being conducted by the government will show enough margin of profit to induce farmers to fertilize their fields in order to secure increased rice yields.

Other farm crops. Although sugar cane is grown in Thailand and a considerable amount of palm sugar is produced, sugar still has to be imported to supplement the local supply.

The tobacco industry of Thailand is controlled by the government. This government monopoly has proved to be beneficial to the farmers as well as to the country's revenue. The income derived by the tobacco monopoly is much more than sufficient to enable it to conduct its own research and extension and to send students abroad for advanced studies in the growing of tobacco and the manufacture of the products.

Thailand farmers grow root crops similar to those grown by Filipino farmers. They grow a considerable amount of peanuts. Most of the peanuts are pressed for the oil which is used as human food, and the peanut-oil cake serves as an important ingredient of

animal feeds. The growing of cassava (fig. 4, upper panel) is popular and the production of cassava starch is increasing. The by-product of the cassava starch industry is fed to ducks and to pigs. The manufacture of cassava starch is still largely done in a crude way, but very recently, a modern starch factory was built in the area where cassava is grown extensively. In this factory, starch is extracted and dried by machinery. Because of the interest in the production of cassava starch, new cassava plantations are being established, and in some cases, even orchards of fruit trees have been cut down and replaced with cassava.



Fig. 4.—Upper panel—A field of young cassava plants. This particular farm is owned by Thuan Komkris, B.S.A. (U.P.), 1934, and is about 120 km. south of Bangkok. Lower panel—In the basket are lamyai (longan), durian, and mangosteen, which are all in season from June to August.

Fruits. There is an abundance of fruits in Thailand. The markets overflow with fruits in season. Number one fruit in Thailand is the durian. In quality, the long-stemmed variety beats any kind available in the Philippines. Mangosteen is the number two fruit. A variety of pummelo is grown in certain regions in Thailand which in quality can compare with the best in the world. Also grown is a kind of santol that is sweet and juicy and is as big as ten or

more centimeters across. It is said that these santol fruits are individually wrapped with paper on the trees from the time that they are big enough till they are ready for harvesting. Although Thailand grows many good varieties of mango, she does not have the Carabao mango, considered to be the pride of the Philippines. The common varieties of mango in Thailand are the *naam dookmai* (nectarine) and the *ockrong*. Both varieties are very sweet. The *thongdaam* (dark gold) is also good, but it is better eaten when green than when ripe. Fruits of this variety are peddled around, already peeled, and are eaten like apples. The *ngo* (rambutan) is also a popular fruit in Thailand. The *lamyai* (longan) (fig. 4, lower panel) is an excellent fruit that should find favor among the Filipinos. Many different varieties of bananas are grown in Thailand but not the popular Lakatan and Latundan of the Philippines. Those who are fond of guavas will find in Thailand big ones which are not very



Fig. 5.—Ridged-up plots are a common sight in Central Thailand. Upper panel—A plot of sweet corn. Lower panel—A plot of tomato plants.

seedy. Guava fruits are likewise peddled, already peeled, and are very popular among the young as well as the old.

Vegetables. From what one sees in the markets, apparently many more varieties of vegetables are grown in Thailand than in the Philippines. Grown in the canals along the streets is a leafy variety of *kangkong* which is very productive. Several varieties of bamboo are cultivated only for the young shoots. There is also the floating *makahia*. Indeed, there are many plants that are considered useless weeds in the Philippines which are utilized as vegetables in Thailand. Many of these plants are used for flavoring the highly condimented Siamese curry.

The commercial growing of vegetables in Central Thailand is a real art. The soil in this region, being heavy clay, drains poorly. Drainage ditches, 8 to 10 meters apart, are therefore dug. Between these ditches, the soil is ridged into rounded beds (fig. 5) so that it becomes higher than the surrounding areas. Thus, a good surface drainage is assured. To grow vegetables in these beds, large quantities of manure are utilized. A considerable amount of duck manure is broadcast on the beds. Cattle manure is not generally used because, according to the vegetable growers, it usually brings in weed seeds and its fertilizing value is low since no efforts are made to prevent leaching. The law prohibits the use of night soil for fertilizing vegetables.

From observations made in Thailand, a number of agriculturally useful plants may certainly be introduced advantageously into the Philippines. It may be worthwhile for the authorities concerned to consider sending an agriculturist to Thailand to explore this possibility. Notable among the plants that may be profitably introduced into this country are varieties of durian, pummelo, santol, mangosteen, longan, and the vegetable bamboos, as well as other varieties of bamboo that are useful in house construction. This list does not include the many flowering plants which add color the year round to the towns, cities, and countrysides of Thailand.

THE RETAILING OF FARM PRODUCTS THROUGH ROADSIDE MARKETS¹

AGUSTIN T. CASTRO

WITH ONE TEXT FIGURE

Roadside markets along the national highways leading to points north and south of Manila were, in the main, operated by buyers and only in a few cases by farm producers. These markets were ordinarily located in the rural districts which produced the particular products handled and were usually on the right side of the road leading to the city.

Markets operating for longer periods had more permanent stands than those operating for short periods. The period of operation of roadside markets varied according to the availability of commodities handled. From March to June a large number of roadside markets were in operation. The largest volume of sales was on Saturdays and Sundays and on holidays, at two o'clock to five o'clock in the afternoon.

With the exception of mature coconut and boiled corn, all of the products sold at the roadside markets were fresh fruits and vegetables which were either produced in the immediate locality or supplied by producers from other towns and provinces.

The retail prices varied from week to week and from season to season among the different roadside markets, having been greatly influenced by supply and demand, quality, perishability, and season of the commodities. The average prices were generally lower than those in the public markets of Manila, Cavite, and Calamba, Laguna. The gross margins averaged 26 per cent of the average retail prices of the products.

The average volume of weekly sales of each roadside market was affected by the kind of commodities sold, prices, consumers' demands, seasonality of production, duration of the period of operation, location of stand, attractive display of products, and traffic of prospective customers.

On the average, the operation of a roadside market for a year cost about ₱672.27, exclusive of the value of the products handled. This amount represented 23 per cent of the total volume of sales of ₱2,904.54.

There are many ways by which producers may dispose of their products either at wholesale or at retail. Whatever means they may employ to move their products from the point of production to the ultimate consumer, their main objective is to secure the greatest profit through efficient marketing methods.

Balmaceda² stated that the present low economic position of the small producer in this country can be attributed, in part, to his inability to market his produce effectively.

¹ Central Experiment Station Contribution No. 1673. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Agricultural Economics under the direction of Instructor Nathaniel B. Tablante.

² BALMACEDA, CORNELIO. 1950. How to market our farm products. *Agricultural and Industrial Life* 12 (4): 6-29.

According to Tablante,³ the opening of good roads for motor transportation has led to the establishment of roadside markets where excursionists ordinarily make retail purchases of products for direct consumption or for home use.

In the United States, Vining⁴ reported that not only have good roads and automobiles made possible the development of many fine roadside markets, but the variety of agriculture, cities, and resort areas have influenced the growth of these markets. Folks going to a resort area not only make purchases on the way but often stop on their trip back to buy fruits and vegetables for table and canning uses.

Hall⁵ declared that highways are "buy-paths" to the farm, where smart, direct-to-consumer merchandizing of farm products can bring a large share of the buyers' food cash. He mentioned that milk, eggs, meat, chickens, a variety of dairy products, fresh fruits, and vegetables can be sold at the roadside markets.

Hart and his associates (1942) stated that a large number of potential customers, a large, attractive display of good-quality produce, satisfactory prices, a well-located stand, courteous service to the repeat-customer trade, and a long season of operation are among the most important factors which contribute to a large volume of sales of roadside markets. They advised that careful study and planning should precede the development of a roadside market.

This study was undertaken in order to explore the economic possibilities and limitations of roadside marketing as a means of selling farm products at retail. The survey was made from July 21, 1951, to June 29, 1952, and the data gathered were immediately analyzed in the Department of Agricultural Economics after each weekly compilation.

METHOD OF STUDY

Roadside stores operating in the provinces of Laguna, Rizal, and Bulacan were surveyed. A total of 120 operators was interviewed weekly for a period of almost one year, with the use of mimeographed schedule forms in Tagalog prepared in the Department of Agricultural Economics. Actual observations were made and photographs were taken to supplement the information gathered from the interviews.

As used in this paper, a roadside market or store is a place of business, with or without stand, near the road or highway in a rural area, carrying on retail transactions of locally grown farm products. The products for sale may not have been produced by the operators

³ TABLANTE, NATHANIEL B. 1950. Retail outlets for the farmer's products. *Agricultural and Industrial Life* 12 (10): 20-21.

⁴ VINING, KEATS. 1950. Roadside market. *Prairie Farmer* 122 (22): 14-15.

⁵ HALL, EMILIE. 1950. Highways are "buy-paths" to the farm. *Country Gentlemen* 120 (9): 27-93.

of the stands themselves; they may have been purchased from other producers.

RESULTS AND DISCUSSION

Description of roadside markets surveyed. A total of 120 roadside markets operating from July, 1951, to June, 1952, in the provinces of Laguna, Rizal, and Bulacan was covered in the survey. The stores were located along the much-traveled national road leading to places both north and south of Manila and in the rural areas known to be producers of the products being sold at retail by these wayside markets.

In contrast to the roadside markets in the United States where the farmers sell their own produce, 82.50 per cent of the roadside stores surveyed here were operated by buyers who purchased from farmers and wholesale merchants (table 1). This is to be expected since only a very limited variety of farm products could be sold at a single stand if the products were only those produced by the proprietors themselves. Furthermore, farmers usually do not have the time to attend to this phase of marketing, for they are occupied most of the time with their farm operations. Under these conditions, little direct marketing to consumers is involved.

The right side of the road going to Manila seemed to be preferred as most customers purchased farm products on their way home from the province. Excursionists, car owners, and regular passengers of buses were the common patrons of these stands.

Not all of the roadside markets had permanent stands for their products (fig. 1, upper panel). Some operators, particularly those whose stores were in short periods of operation according to the seasonality of the products handled, had only display tables under the shade of large trees; others had temporary sheds (fig. 1, lower panel), and still others had no stands at all (table 2). Almost always, however, the roadside markets were in sites where a field or an orchard growing the commodities offered for sale was clearly visible from the highway, thereby giving the impression that the products on sale had been gathered from there and were, therefore, fresh.

The estimated value of the roadside stands ranged from ₱15 to ₱600, an average of ₱21 for temporary, uncovered stands, ₱51.09 for temporary, roofed stands, and ₱145.10 for permanent stands, or an over-all average of ₱83.56 for all stands.

Period of operation. One of the important factors determining the period of operation of roadside markets was the availability of the commodities handled.

The stores in Pansol, Calamba, Laguna, which handled bananas and green coconuts were open the year round; those in Los Baños, Laguna, handling coconuts and assorted kinds of fruits were in business for an average period of eight months, although many of them

had a year-round business. The period of operation of stands handling avocado and pineapple in Calauan, Laguna, was three months; stands in Calamba, Laguna, handling seasonal fruits and vegetables operated for five months; those in Bayanan, Muntinlupa, Rizal, and in Guiguinto, Bulacan, selling melons, watermelons, and mangoes, for about four months.



Fig. 1.—Upper panel, a permanent stand in Guiguinto, Bulacan, with melons, watermelons, and mangoes. Lower panel, a temporary, covered stand in Guiguinto, Bulacan, with mangoes, melons, and watermelons on display.

The largest number of stands operated in May, April, June, and March, or during the summer months when most people go on excursions or trips to the provinces. The largest part of the business of roadside markets was done on Saturdays and Sundays and on holidays. Stands were generally open from 5:30 o'clock in the morning

to about 7:00 o'clock in the evening, the largest volume of sales occurring at 2:00 to 5:00 o'clock in the afternoon.

For the most part, the roadside stands in Guiguinto, Bulacan, were open during the four-month period, March to June, not only because the products handled were readily available during these months, but also because it was the only time farmers were off their work in the rice fields. Incidentally, the barrio of Tabang in Guiguinto, Bulacan, had the greatest number of roadside markets of all the places surveyed, and practically all of them were in operation during this four-month period.

The period of operation also varied according to the type of stand. The more permanent the stands were, the longer they remained open for business.

Kinds of products handled. Except for coconut and corn, fresh fruits and vegetables seemed to make up the bulk of the commodities sold at the roadside markets. During the year, 35 different kinds of locally grown farm products were handled at various seasons (table 3). All of these kinds were not on sale at any one store at any particular time, however, since each individual stand handled different products depending upon its location and the season it was open. If all of the 35 kinds could have been handled by one stand, the average sales for the year would have amounted to ₱2,904; sales from boiled green corn, singkamas, lanzones, Carabao mango, pineapple, and watermelon would have represented more than two-thirds of the total. From the standpoint of aggregate sales made by all stands, however, Carabao mango, green coconut, watermelon, singkamas, lanzones, pineapple, and boiled corn contributed a large portion to the grand total sale of ₱348,544. Only a few kinds were available throughout the year; the rest were on sale from one week to six months.

The stands at College Junction, Los Baños, Laguna, sold assorted kinds of fruits in addition to green coconut and makapuno. Those in Pansol, Calamba, Laguna, handled green coconut and three varieties of bananas; those in Calamba, Laguna, singkamas, lanzones, corn, melon, and watermelon; in Bayanan, Muntinlupa, Rizal, Carabao mango, melon, and watermelon; and in Guiguinto, Bulacan, mango, green coconut, and watermelon.

Individual markets handled different commodities either singly or in combination with other products. All of the 120 markets surveyed were classified into 18 different types according to the kind or kinds of products handled by each. On this basis, the stores selling lanzones alone had the highest average total sales made by individual stands for the year, although they had the shortest duration of business operation.

The products handled in these markets were more fresh and were of better quality than those sold in the public markets. The quality of the fresh fruits and vegetables was arbitrarily determined

on the bases of freshness, size, general appearance, and absence of mechanical injuries. Stocks were commonly changed twice or three times a week. An insignificant portion of the stocks remained unsold after three or four days on display, and the quality of these products was lowered. They had to be sold at slightly lower prices which were, however, still greater than, or at least equal to, the prices at which they were purchased.

Sources of products handled. The farm products sold at the different roadside markets were either produced in the locality and the immediate vicinity or were supplied by producers from other places. They were transported by truck, cart, or carretela when the sources were far from the selling place or merely hauled by man when the stands were near the field or orchard where the products were gathered.

The principal source of pineapple was Calauan, Laguna; of green coconut and makapuno, Los Baños, Laguna; of lanzones, Paete, Laguna; of citrus and siniguelas, Santo Tomas and Tanauan, Batangas; and of melon, watermelon, and Carabao mango, Muntinlupa, Rizal, Candaba, Pampanga, and Bustos and Santa Maria, Bulacan.

The pineapple and avocado fruits sold at stands in Calauan, Laguna, were produced in the town itself. In Los Baños, Laguna, the markets derived their products from farms in the town; in addition they got most of their lanzones from Bay and Paete, Laguna, and their other fruits from Calauan and a few towns in Batangas province. The bananas sold in Pansol, Calamba, Laguna, were produced in the locality; the supply of green coconuts came from Los Baños. All of the singkamas sold in Calamba, Laguna, were from the town itself; the lanzones fruits, from Santa Cruz and Paete, Laguna; green corn, from Santo Tomas and Tanauan, Batangas, and from Calauan, Laguna; most of the melons and watermelons, from Candaba, Pampanga, and from Bustos and Santa Maria, Bulacan.

All mangoes sold in Báyanan, Muntinlupa, Rizal, were produced in the locality. Although the town is known as a producer of melons and watermelons, a large part of the supply of these vegetables during the year came from Pampanga and Bulacan. Similarly, the barrio of Tabang, Guiguinto, Bulacan, produced all the mangoes sold in the roadside markets there, but its watermelons were supplied by Candaba, Pampanga, and Bustos, Bulacan, and its green coconuts, by Santo Tomas and Lipa, Batangas, as well as by Los Baños, Laguna.

Roadside stands operated by farm producers handled only those products raised in the producers' own farms; those operated by buyers derived their supply mostly from the neighboring farmers and sometimes from the public markets. The buyers obtained these farm products at wholesale prices and sold them at retail prices.

Prices and gross margins. Table 4 shows the average retail prices and gross margins realized from the sale of different farm products at the roadside markets surveyed. Prices fluctuated from

week to week and from season to season; they were generally high at the start and near the close of one season and low at the height of the period of availability of each kind. To measure the variation of the seasonal price movements of the different commodities, the coefficient of average seasonal price fluctuation was used. This constant is derived as a percentage by dividing the difference between the highest and lowest average prices by the average of these two prices. The products with the highest coefficients were Carabao mango (123.23 per cent), melon (108.80 per cent), watermelon (106.38 per cent), star apple (77.75 per cent), and lanzones (62.56 per cent). It may be noted that these products are either more seasonal or more perishable than the others. These findings seem to corroborate the statement of Shepherd (1941) that the prices of perishable crops can be expected to fluctuate reasonably more than the prices of the more durable or storable crops.

Variations in prices may be primarily explained by the interaction of the forces of supply and demand when other factors are held constant. The price of any commodity at a given time varies inversely with the quantity of that commodity offered for sale and directly with the quantity that the consumers are willing to purchase. Thus, when the product is in season, the supply is relatively greater than the demand, and, therefore, the price tends to be low. It often happens, however, that the period of availability of a particular product coincides with the period of great demand, as during the summer months. Under this condition, the price is influenced by whichever factor, supply or demand, is greater.

The quality of the product is another factor affecting price. Products of higher quality, as evidenced by freshness, general appearance, and physical condition of the commodity, command better prices, other considerations being equal.

According to Clark and Clark (1942), the prices received for farm products at roadside markets vary greatly, but that in general, the most successful markets price goods below local retail prices and above those the farmer would receive if he sold his products at wholesale, but as near the former as competitive conditions will allow. Two of the major reasons that people give for patronizing roadside markets are that they wish to obtain fresh products and they hope to secure these produce at a price lower than what they would have to pay at the retail store in the town (Hart, Bond, and Cunningham, 1942). In this study it was observed that the average retail prices of farm products sold in the roadside markets were relatively lower than those for similar kinds in the public markets in Manila, Cavite City, and Calamba when the price data were compared, commodity for commodity, with those gathered from the Bureau of Commerce weekly price reports, from Tablante and Tirona (1951), and from Hosillos (1952).

Even for the same commodities, different retail prices prevailed in different roadside markets. Carabao mangoes were sold in Baya-

nan, Muntinlupa, Rizal, at an average of ₱2.20 a dozen, or ₱0.17 lower than the price in Guiguinto, Bulacan (₱2.37). The roadside stands in the province of Laguna sold watermelons at an average price of 86 centavos each, which was 25 centavos higher than that in Bulacan (61 centavos each) and 14 centavos more than the price charged in Rizal (72 centavos). Green coconuts sold for about 8 centavos each in Laguna, whereas in Bulacan, they sold for about 18 centavos each. Such differences in prices for similar commodities may be directly attributed to added handling and transportation expenses incurred when the sources were quite remote from the roadside markets handling these products.

The average gross margin realized by the roadside market operators ranged from 17.67 per cent of the average retail price of the products, as with green coconuts, to as high as 73.46 per cent, with Saba bananas, or a general average of about 26.01 per cent of the selling price of all commodities for the entire period (table 4). The products whose gross margin represented one half or more of the average retail price were Valencia oranges (60 per cent), Lacatan bananas (57 per cent), Ladu mandarins (55 per cent), Latundan bananas (53 per cent), mabolo (48 per cent), tiesa (50 per cent), and Bungulan bananas (50 per cent). For some commodities, such as lanzones, mangoes, pineapples, watermelons, and makapuno, the gross margins in terms of actual amounts received were high, but they represented only a small portion of the prevailing average retail prices of these particular products.

Table 5 shows the monthly variations in average total sales and total value of the products sold at each roadside market. The difference between the amount received from the sales and the amount paid for these products represents the total gross margin for a particular month. Although the total amount of sales for the month of August was the highest, the average gross margin was only 16 per cent of this volume of sales; it was the lowest proportion of the total gross margin on this basis. Roadside market operators took, on the average, a gross profit equal to about 26.01 per cent of their selling price for all commodities handled. Except during the months of April, May, June, and August, the gross margins realized on the sale of farm products at the roadside stands remained fairly constant.

Relation of volume of sales to various factors. The aggregate volume of sales of all stands was high from the last two weeks of March to the early part of June. This may be explained by the fact that during these months, many kinds of commodities were sold. Business was brisk because of the large number of excursions and trips held at the time and also because many operators were included in finding the aggregate sale of all stands.

The volume of business of roadside markets varied from week to week. The average weekly sales of each stand were highest in July and August, possibly because during this period only a few markets were in operation, so that they virtually monopolized the

business. The average weekly sales of each stand were low from September to January, started to increase in February, then became high during the three-month period from March to May.

Several other factors affected the volume of sales of roadside markets. The kinds of commodities handled determined to a large extent the total income from sales. Stands selling products which were generally in great demand and for which consumers were willing to pay high prices, such as lanzones, singkamas, watermelon, and assorted fruits and coconuts, obtained higher returns. In general, more sales were made from seasonal products than from those available throughout the year. The duration of operation of the market also affected the amount of sales. Stores that were open regularly for a longer period and those which had more permanent stands had higher volumes of sales. Location of stand, as well as neatness and attractiveness of display of fresh products, played an important role in increasing sales. A large, well-arranged display of fruits and vegetables that could readily be seen by the customers even at a distance induced them to stop and make their purchases. Not to be overlooked was the frequency of customers passing along the highways where the stand was located. During summer the volume of sales was large, and business of the roadside markets was good. Much of the business of roadside markets depends on the number of traveling customers who are attracted to buy the fresh products, which they consume on the spot or which they take home from their trips. In other words, a large amount of traffic passing by the roadside markets is essential in getting sales large enough for efficient operation.

Costs of operation. The average operating costs of the 120 roadside markets studied are shown in table 6. For each stand, the cost of operation averaged ₱672.27, which was equal to 23.15 per cent of the total volume of sales of ₱2,904.54. This means that of every peso's worth of sale, about 23 centavos went to meet operating expenses.

The largest item of expense, aside from the value of the products sold, was labor, which took more than four-fifths of all the operating expenses. The roadside market operators placed the value of their labor and that of their family's at a fixed rate equal to 20 per cent of the gross sales. Inasmuch as no hired labor was involved, this item of expense would also go to the operator and his family as part of their earnings from selling products by the wayside. In addition, the operator received the amount allotted for the use of capital and for the depreciation of building and equipment, as well as a net profit of ₱83.16, the residual amount left after paying all business expenses. This means that the average operator of a roadside stand received about one-fourth of the total amount of the sales for the time he and his family put into operating the business, for interest on his average capital investment, for depreciation of building and

equipment, plus a net profit. When the operator sells the products which he raises on his farm, it is evident that he gets practically the whole amount of sales from retailing farm products through the medium of the roadside market.

Increased volume of sales reduced the operating expenses for each unit of sales (table 7). The greater the total sales, the lesser the total expenses for each peso of sales, since the costs were distributed over a larger volume. Total expenses were 3.75 per cent of total sales for markets having an average weekly sales of ₱100 or less, but only 0.85 per cent for those selling more than ₱400 a week.

CONCLUSIONS

1. Retailing farm products through roadside markets is a profitable business undertaking, particularly if the products sold are produced by the operator himself. These markets are usually operated at certain seasons of the year generally coinciding with the off-periods of farm operations, so that they provide an additional source of income for the operators.

2. Since labor is the largest single item of cost, it would be well for the operator of a roadside market to consider whether his family labor or his own labor used in operating the market can find better returns if otherwise employed in the farm operations. If the volume of business is not large enough, it may be more profitable to sell his products to buyers who come to his farm.

3. Not only fruits and vegetables but also other kinds of farm products, such as poultry and eggs, milk, flowers, and ornamental plants, can be sold directly to the consumer through roadside markets. The important thing to remember is that the profitableness of the enterprise will depend greatly on the ability of the operator to insure a continuous supply of farm products that are in constant demand by the consumer-patrons of the market. There are very good prospects for this means of retailing farm products, and all possibilities of increasing sales through this medium should be explored.

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TABLE 1

Locations and status of operators of the roadside markets surveyed

LOCATION	NUMBER OF STANDS SURVEYED	STATUS OF OPERATOR		PERCENTAGE OF TOTAL	
		Producer	Buyer	Producer	Buyer
Province of Laguna					
Los Baños	16	1	15	0.83	12.50
Pansol, Calamba	3	1	2	0.83	1.67
Calamba	16	6	10	5.00	8.33
Calauan	5	4	1	3.34	0.83
Total for Laguna ...	40	12	28	10.00	23.33
Province of Rizal					
Bayanan, Muntinlupa ..	14	3	11	2.50	9.17
Province of Bulacan					
Tabang, Guiguinto	66	6	60	5.00	50.00
Total of all stands	120	21	99	17.50	82.50

TABLE 2

Relation of type of stand to total sales

TYPE OF STAND	STANDS REPORTING		AVERAGE VALUE OF STAND	AVERAGE NUMBER OF WEEKS OPEN	AVERAGE WEEKLY SALES	AVERAGE MONTHLY SALES
	Number	Percentage				
			<i>pesos</i>		<i>pesos</i>	<i>pesos</i>
No stand	15	12.50	—	16.00	70.22	281.13
Temporary, uncovered ..	13	10.83	21.00	16.46	81.94	327.76
Temporary, covered	42	35.00	51.09	18.74	127.64	510.56
Permanent	50	41.67	145.10	19.48	245.07	980.28
Average, all stands			83.56	18.72	164.24	657.80

TABLE 3

*Relative importance of kinds of products based on
the amount of sales*

PRODUCTS	AVERAGE NUMBER OF WEEKS ON SALE	NUMBER OF STANDS REPORT- ING	AVERAGE WEEKLY SALES	AVERAGE ANNUAL SALE OF EACH STAND	TOTAL SALES	PERCENT- AGE OF TOTAL SALES
Mango, Carabao	22	48	176.88	2,129.90	102,235.80	29.33
Coconut, green	50	57	52.67	1,044.13	59,515.41	17.08
Watermelon	14	26	180.16	1,933.27	50,265.05	14.42
Lanzones	12	11	273.72	2,438.64	26,825.00	7.70
Singkamas	18	10	154.89	2,511.53	25,115.25	7.21
Pineapple	18	9	243.29	2,015.50	18,139.50	5.20
Melon	15	14	90.33	903.29	12,646.10	3.63
Coconut, macapuno	45	12	28.63	706.14	8,473.72	2.43
Corn, boiled	37	2	142.58	3,778.50	7,557.00	2.17
Banana, Latundan	50	14	22.07	518.62	7,260.65	2.08
Chico	42	11	33.61	455.31	5,008.40	1.44
Banana, Lacatan	50	14	23.49	354.04	4,956.50	1.42
Avocado	22	12	38.61	353.92	4,247.07	1.22
Banana, Buñgulan	48	14	17.18	268.74	3,762.32	1.08
Star apple	15	8	52.82	462.18	3,697.50	1.06
Banana, Saba	47	14	16.19	193.07	2,703.00	0.78
Ubi	18	9	15.33	137.96	1,241.65	0.36
Coconut, mature	28	11	2.05	84.06	924.64	0.27
Papaya	17	10	9.76	66.36	663.55	0.19
Atis	9	9	12.76	73.72	663.50	0.19
Guayabano	6	9	20.25	68.35	647.95	0.18
Mango, Indian (green)	6	5	21.59	103.64	518.20	0.15
Mabolo	4	6	20.69	55.18	331.05	0.09
Citrus, King mandarin	4	5	37.63	60.20	301.00	0.08
Nangka	7	7	6.50	26.00	182.00	0.05
Citrus, Valencia orange	1	3	50.00	50.00	150.00	0.04
Citrus, Szinkom mandarin ..	6	6	18.33	24.24	146.65	0.04
Citrus, pummelo	11	8	7.15	12.51	100.10	0.03
Santol	3	5	10.17	18.31	91.55	0.03
Citrus, Batangas Mandarin	2	2	35.00	35.00	70.00	0.02
Siniguelas	6	3	9.87	19.73	59.20	0.02
Citrus, calamandarin	1	1	15.00	15.00	15.00	£
Citrus, Ladu mandarin	1	1	15.00	15.00	15.00	£
Cucumber	1	1	10.00	10.00	10.00	£
Tiesa	1	1	5.00	5.00	5.00	£
Total		120			348,544.31	100.00

£—Less than 0.01 per cent.

TABLE 4

Average prices and gross margins realized from the sale of products in 120 roadside markets from July 21, 1951, to June 29, 1952

FARM PRODUCTS SOLD		AVERAGE RETAIL PRICE FOR THE YEAR	AVERAGE FARM PRICE FOR THE YEAR	AVERAGE GROSS MARGIN FOR THE YEAR	GROSS MARGIN IN RELA- TION TO RETAIL PRICE	COEFFI- CIENT OF AVERAGE SEASONAL FLUCTUA- TION
		centavos	centavos	centavos	per cent	per cent
Laguna Province						
Atis	each	4.74	2.62	2.12	44.73	5.76
Avocado	kilo	27.47	14.45	12.88	46.89	44.39
Banana:						
Bungulan	each	2.41	1.15	1.20	49.79	29.66
Lacatan	each	2.55	1.10	1.45	56.86	34.80
Latundan	each	2.18	1.03	1.16	53.21	27.44
Saba	each	2.11	.56	1.55	73.46	31.48
Chico	each	4.14	2.21	1.88	45.41	45.95
Citrus:						
Batangas mandarin ..	each	7.75	5.00	2.25	29.32	58.06
Calamandarin	each	5.00	3.00	2.00	40.00	0.00
King mandarin	each	14.69	9.00	5.69	38.73	33.33
Ladu mandarin	each	10.00	4.50	5.50	55.00	0.00
Pummelo	each	27.48	15.99	11.46	43.81	58.82
Szinkom mandarin ...	each	5.50	3.44	2.06	37.45	28.57
Valencia orange	each	8.00	3.20	4.80	60.00	0.00
Coconut:						
Macapuno	each	124.80	87.70	35.79	28.68	41.19
Mature	each	6.19	4.15	1.95	29.15	44.75
Green	each	8.60	7.07	1.52	17.67	43.45
Corn, boiled	each	3.71	1.99	1.42	38.27	43.90
Cucumber	each	10.00	6.00	4.00	40.00	0.00
Guayabano	each	42.50	28.76	12.90	30.35	58.82
Lanzones	kilo	115.87	83.23	31.32	27.02	62.56
Mabolo	each	5.81	3.00	2.81	48.36	24.00
Mango, Indian	each	9.27	6.71	2.55	27.51	28.57
Nangka	each	101.46	77.42	34.83	31.82	27.27
Papaya	each	43.71	26.41	17.82	40.77	44.48
Pineapple	each	90.96	66.42	24.54	26.99	22.73
Sineguelas	each	0.76	0.55	0.22	28.95	54.78
Singkamas	each	34.32	22.15	11.80	34.38	58.01
Santol	each	2.33	1.35	.97	41.63	12.77
Star apple	each	15.40	10.42	4.28	27.79	77.75
Tiesa	each	10.00	5.00	5.00	50.00	0.00
Ubi	kilo	35.31	23.70	10.93	29.30	13.33
Watermelon	each	85.80	57.64	27.89	32.51	106.38
Rizal Province						
Mango, Carabao	dozen	220.60	163.84	47.71	21.63	14.90
Melon	each	27.54	21.79	9.04	32.82	108.80
Watermelon	each	71.58	53.87	17.72	24.76	86.59
Bulacan Province						
Coconut, green	each	17.91	10.00	7.91	44.17	6.19
Mango, Carabao	dozen	237.50	169.91	67.97	28.62	123.23
Watermelon	each	61.35	37.83	14.52	23.67	94.74

TABLE 5

Seasonal variation in the sales and cost of products sold at the roadside stands

MONTHS	NUMBER OF STANDS REPORT- ING	TOTAL SALES OF ALL STANDS	AVERAGE MONTHLY SALES A STAND	TOTAL VALUE OF FARM PRODUCTS	AVERAGE MONTHLY VALUE OF PRODUCTS	PROPOR- TION OF TOTAL GROSS MARGIN TO VOL- UME OF SALES
		<i>pesos</i>	<i>pesos</i>	<i>pesos</i>	<i>pesos</i>	<i>per cent</i>
July	8	4,781.83	597.73	3,348.80	418.54	29.98
August	20	25,008.17	1,250.41	21,021.85	1,051.09	15.94
September ..	21	18,541.06	882.91	12,919.78	615.23	30.32
October	20	9,793.33	489.67	6,500.15	325.01	33.63
November	21	6,574.13	313.05	4,315.61	205.51	34.35
December	15	7,363.95	490.93	4,717.56	314.51	35.94
January	21	11,368.21	541.34	7,729.06	368.05	32.01
February	35	19,789.79	565.42	13,265.50	379.00	32.97
March	102	57,797.22	566.64	39,927.82	391.45	30.92
April	111	76,945.28	693.20	59,413.70	535.26	22.78
May	120	68,223.52	568.53	51,369.40	428.08	24.70
June	105	42,357.82	403.41	33,363.41	317.75	21.23

TABLE 6

Average cost of operating a roadside stand

ITEMS	AVERAGE AMOUNT	PERCENTAGE OF TOTAL SALES	PERCENTAGE OF TOTAL EXPENSES
Total sales	2,904.54	100.00	—
Value of products sold	2,149.11	73.99	
Gross margin	755.43	26.01	
Operating expenses, cash and non-cash:			
Labor	580.91	20.00	86.41
Containers used	2.52	.09	.40
Rentals and fees	5.70	.20	.84
Miscellaneous	5.00	.17	.74
Depreciation of building and equipment ..	15.99	.55	2.37
Interest on average capital invested	62.15	2.14	9.24
Total operating expense	672.27	23.15	100.00
Net profit	83.16	2.86	12.37

TABLE 7

Relation of total sales to operating expenses

RANGE OF WEEKLY SALES	NUMBER OF STANDS REPORTING	AVERAGE WEEKLY SALES	AVERAGE WEEKLY EXPENSES	PROPORTION OF TOTAL EXPENSES TO TOTAL SALES
		<i>pesos</i>	<i>pesos</i>	<i>per cent</i>
P100 or less	38	61.91	2.32	3.75
P101-P200	53	154.04	4.85	3.15
P201-P300	19	238.44	6.54	2.74
P301-P400	7	342.48	6.49	1.89
P401 or over	3	664.15	5.64	0.85

ANIMAL PROTEIN FACTOR AS A SUPPLEMENT TO A GROWING RATION FOR CHICKS WITH ROASTED MUNGO MEAL AS THE PRINCIPAL PROTEIN INGREDIENT¹

ALFONSO M. LAGMAN

WITH ONE TEXT FIGURE

Chicks that were given an all-vegetable ration with roasted mungo meal as the principal protein ingredient and supplemented with animal protein factor were heavier than those given an unsupplemented ration, but in spite of their weight, the chicks had poor growth. Mortality was very much higher in the control lot, which was not given animal protein factor, than in the experimental lot. Feathering, pigmentation, and beak, comb, and wattle development of the birds in the control lot were subnormal, whereas those in the experimental lot were normal in all respects.

Although the animal protein factor markedly improved the ration, the improvement was too inadequate to justify the use of the ration.

Although mungo contains a good amount of protein, it is insufficient when used as the only protein supplement in either growing or laying rations. The unfavorable effects of mungo (Adan, 1935, and Badua²) may be due to its having certain factor or factors that inhibit the growth of chicks or to its lack of certain dietary essentials.

Borchers and his co-workers (1947) reported that heating improves the feeding quality of soybean meal. Couch³ and Johnson (1949) reported on the effectiveness of animal protein factor as a feeding supplement in all-plant protein rations for chick growth. Bird, Rubin, Whitson, and Haynes (1946) and Wiese, Petersen, and Lampman (1948) proved that supplementing an all-vegetable growing ration with animal protein factor results in increased chick growth and in lower mortality.

This study was conducted in the Department of Animal Husbandry from December, 1950, to January, 1952, to determine the influence of animal protein factor supplement upon the feeding quality of a growing ration with roasted mungo meal as the principal protein material.

¹ Central Experiment Station Contribution No. 1674. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1952. Prepared in the Department of Animal Husbandry under the direction of Dr. F. M. Fronda and Mr. A. C. Campos.

² BADUA, FELIPE. The influence of rations with varying amounts of fish and mungo (*Phaseolus aureus* Linn.) meals supplemented with cow manure on the growth of chicks. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, 1950. Unpublished.)

³ COUCH, J. R. August 8-12, 1949. Address delivered at the Vitamin Section, Gordon Research Conference, New London, New Hampshire.

MATERIALS AND METHODS

A total of 306 newly hatched New Hampshire chicks from four different hatches was used in four trials of twelve weeks each, made at different times. In each trial there were a control lot and an experimental lot between which the chicks were divided at random. Each chick was legbanded and weighed weekly until the end of the experiment.

The basal ration used contained the following ingredients, all parts by weight:

INGREDIENT	WEIGHT
Rice bran, fine	55.0
Corn, ground	20.0
Mungo meal, roasted	70.0
Copra meal	5.0
	150.0

The quantity of mungo used in this ration was calculated to furnish as much crude protein as that supplied by 20 kilograms of fish meal. The proximate chemical analysis of mungo meal used, as determined by the Department of Agricultural Chemistry, is as follows:

	PERCENTAGE
Moisture	14.70
Ash	3.01
Crude protein	20.44
Crude fiber	4.36
NFE	56.56
Fat	0.93

Mungo meal was roasted in a coffee roaster of the Department of Agronomy at a temperature of 315.5°C. (600°F.) until it acquired a pleasant nut-like taste and a brownish color.

Both lots were given the basal ration, but the ration of lot II was supplemented with one part of animal protein factor. The feeds were given in the form of dry mash and were made accessible to the birds at all times. Fresh water was given *ad libitum*. From the third week until the end of the experiment, the chicks were supplied daily with chopped young ipil-ipil (*Leucaena glauca* Linn.) leaves, ground shells, and grit.

The chicks in both lots were kept in heated battery brooders during the first eight weeks of the experiment. They were then transferred to unheated battery cages where they remained until the end of the study. The chicks were exposed to the morning sunlight for at least 30 minutes. Except for the difference in rations, the environmental conditions afforded to both lots were almost identical.

The initial and weekly weights of the chicks, their weekly feed consumption, mortality, rate of feathering, and other observations were recorded.

RESULTS AND DISCUSSION

Rate of growth. The average weekly weights of the chicks (table 1) served as criteria in determining the influence of the two rations on the growth of the New Hampshire chicks. In all the trials, the chicks in both lots had practically the same weight at the beginning of the experiment and after the first week of feeding. From the second week, the experimental lot consistently gained over the control lot. At the end of the experiment, lot II registered an average weight of 450.9 grams in trial I, 395.4 grams in trial II, 357.8 grams in trial III, and 283.8 grams in trial IV, as against 172.8, 193.5, 166.0, and 182.4 grams in the respective trials of lot I. In all trials, the average weights of the APF lot differed markedly from those of the control lot at the end of the experiment.

The 12-week-old chicks in the study made by Bandong⁴ had markedly higher mean weights than the chicks in both lots in this study. Bandong used chicks of the same breed as those in this study, but the rations he used contained fish meal instead of mungo meal as the major protein ingredient.

The results of this study indicate that APF supplement improved the ration containing roasted mungo meal as the primary protein ingredient, but it failed to induce a normal rate of growth in the chicks. The low biological value of roasted mungo meal was noted when the final weights of both lots were compared with those reported by Badua. That writer found that the lot given raw mungo meal as the sole protein ingredient attained an average weight of 345.6 grams in 12 weeks.

Feed consumption and feed cost. Table 2 shows the total feed consumption of the birds in both lots in each trial. Lot II consumed more feed than lot I in all trials. Each bird in lot II was found to have consumed an over-all average of 1.62 kilograms, and each bird in lot I, 0.84 kilogram. These figures are much lower than those obtained by Badua who found that chicks fed with 20 per cent fish meal consumed more feed than those fed with 20 per cent mungo. The low consumption of feed may be attributed to the unpalatability of the rations and/or the loss of appetite of the birds.

Table 2 also shows the amount of feed required to produce a kilogram gain in weight. In this respect, the APF-supplemented diet was more economical than the unsupplemented diet. On the average, lot I needed 5.85 kilograms, and lot II, 5.00 kilograms of feed to put on a kilogram gain in weight. Likewise, the cost of feeding lot I was more than that of lot II, despite the fact that the ration given to lot I cost ₱0.38 a kilogram and that to lot II, ₱0.43 a kilogram.

⁴ BANDONG, FRANCISCO. A comparative study of two rations for growing chicks. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, 1952. Unpublished).

Since chickens are fed for profit, the returns above feed cost may be considered the final test of a ration. In this regard, lot I showed an overhead of ₦4.12, ₦3.93, ₦4.40, and ₦4.93 in the four consecutive trials. Lot II netted a gain of ₦14.01 and of ₦5.96 in trials I and II, but it registered a loss of ₦0.68 and of ₦3.52 in trials III and IV. The average returns above feed cost of the four trials were ₦4.34 for lot I and ₦3.95 for lot II. These returns are too small to justify the use of either ration.

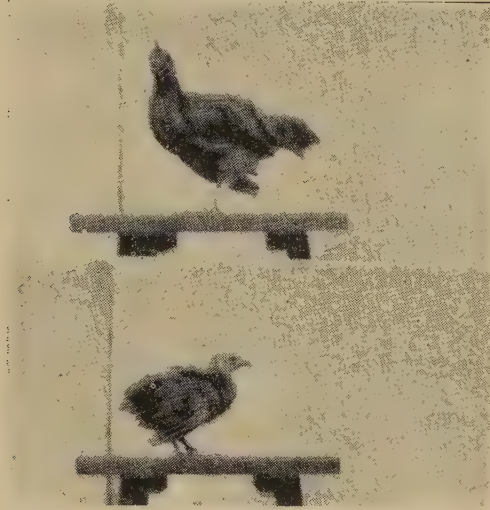


Fig. 1.—Upper panel, a typical 12-week-old New Hampshire weanling from the experimental lot. Lower panel, a typical 12-week-old New Hampshire weanling from the control lot.

Mortality. Table 3 shows the effect of the rations on the mortality of the chicks. Lot I had comparatively higher death rates. The mortality was 42.86 per cent in trial I, 53.06 per cent in trial II, 85.19 per cent in trial III, and 91.07 per cent in trial IV, compared with 33.33 per cent, 36.73 per cent, 44.44 per cent, and 64.29 per cent in the corresponding trials of lot II. The average of the percentages of mortality for lot I was 71.24 and for lot II, 47.71. There were 23.53 per cent more deaths in the control lot. The mortality figures for lot I were much higher than those obtained by Badua.

In both lots, constitutional weakness apparently due to nutritional starvation caused the majority of deaths. The birds that died in both lots, especially in lot I, were observed to have shown signs of loss of appetite followed by emaciation and decrease in vigor. These results seem to indicate that roasting decreases the feeding value of mungo, and even with the addition of animal protein factor,

roasted mungo as the major protein ingredient in an all-vegetable diet for chicks can not improve the vitality of the chicks.

Minor observations. Hand in hand with subnormal body growth, poor feather development, long, thin, and elongated beaks, less deposition of yellow pigment in the shanks, beaks, and skin, and less developed combs and wattles were exhibited by the birds in the control lot. On the other hand, the experimental birds showed normally developed feathers, shorter and stockier beaks, a fair degree of yellow pigmentation, and a much more pronounced comb and wattle development. Figure 1 shows the typical appearance of weanlings produced in lots I and II.

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TABLE 1
Average initial and weekly weights of New Hampshire
chicks in both lots

AGE	TRIAL I		TRIAL II		TRIAL III		TRIAL IV		AVERAGE	
	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II
	grams	grams	grams	grams	grams	grams	grams	grams	grams	grams
Day-old	38.4	39.7	38.2	38.5	37.1	37.0	37.4	37.6	37.8	38.1
1 week	52.3	53.1	48.2	47.7	46.7	47.5	44.7	45.1	47.2	47.4
2 weeks	64.0	72.1	54.5	59.2	53.0	62.9	47.6	48.3	53.1	57.9
3 "	76.0	83.2	59.1	73.4	56.3	73.6	47.4	49.8	57.3	66.8
4 "	82.5	96.8	61.3	86.9	56.6	77.3	53.6	62.2	61.8	78.8
5 "	89.5	118.3	63.4	103.4	63.3	90.8	62.7	79.1	68.1	96.4
6 "	93.6	137.9	67.8	123.2	69.3	110.8	55.9	84.5	69.9	113.1
7 "	96.0	168.3	72.3	143.0	77.4	127.2	75.1	105.8	79.5	134.6
8 "	98.0	207.9	94.6	188.7	86.2	159.9	83.4	128.2	92.0	171.2
9 "	101.0	237.0	102.5	227.2	96.2	197.0	86.1	149.6	97.7	203.2
10 "	109.7	274.6	139.0	297.5	96.7	236.2	98.6	176.2	119.1	250.6
11 "	148.9	370.4	157.0	329.9	125.5	273.0	138.4	211.3	149.8	298.2
12 "	172.8	450.9	193.5	395.4	166.0	357.8	182.4	283.8	184.1	370.2

TABLE 2
*Amount and cost of feed to produce a kilogram gain in weight and returns above feed cost in both lots
 (based on 100 chicks)*

I T E M	TRIAL I		TRIAL II		TRIAL III		TRIAL IV		AVERAGE	
	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II
Total amount of feed consumed, kilograms	80.10	177.13	90.77	170.03	75.78	168.00	83.03	140.19	82.42	163.84
Total cost of feed, pesos ^a	30.44	76.17	34.49	73.11	28.80	72.24	31.55	60.28	31.32	70.45
Average feed consumption of each bird, kilograms	0.80	1.80	0.91	1.70	0.76	1.68	0.83	1.40	0.84	1.62
Weanlings produced, kilograms	17.28	45.09	19.21	39.54	16.60	35.78	18.24	28.38	17.83	37.20
Average gain in weight of each bird, kilograms	0.13	0.41	0.16	0.36	0.13	0.32	0.18	0.25	0.15	0.33
Feed required for every kilogram gain, kilograms	5.96	4.31	5.84	4.76	5.88	5.24	5.73	5.69	5.85	5.00
Cost of feed to produce a kilogram gain, pesos	2.27	1.85	2.22	2.05	2.23	2.25	2.18	2.45	2.22	2.15
Return from sales of weanlings, pesos ^b	34.56	90.18	38.42	79.07	33.20	71.56	36.48	56.76	35.66	74.40
Returns above cost of feed, pesos	4.12	14.01	3.93	5.96	4.40	0.68	4.93	3.52	4.34	3.95

^a Cost of a kilogram of mash mixture: Lot I, ₱0.38; lot II, ₱0.43.

^b Cost of weanling for every kilogram live weight was ₱2.00.

TABLE 3
Mortality of the chicks in both lots

I T E M.	TRIAL I		TRIAL II		TRIAL III		TRIAL IV		TOTAL	
	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II
Number of chicks at start ...	21	21	49	49	27	27	56	56	153	153
Number of weanlings after 12 weeks	12	14	23	31	4	15	5	20	44	80
Number of chicks that died ..	9	7	26	18	23	12	51	36	109	78
Percentage of mortality	42.86	33.33	53.06	36.73	85.19	44.44	91.07	64.29	71.24	47.71

PECHAY GROWING ¹

P. S. FAJARDO

WITH THREE TEXT FIGURES

Pechay of the Chinese variety has been grown every year in the horticulture projects of the U. P. Rural High School. From the lot of one-fourth hectare planted to this crop, 32,160 heads, or 5,259 kilograms, were produced in one harvest season. The steps followed in growing and harvesting the pechay plants are given below.

Pechay (Pe-tsai) or Chinese cabbage (*Brassica pekinensis* [Lour.] Skeels) is an annual crop belonging to the cabbage family Cruciferae. Grown for its tender and succulent leaves, it is used as salad and as an important ingredient in several Filipino and Chinese dishes.

Pechay is native to eastern China and possibly to Japan. This plant was not known in the Philippines until it was introduced here, most probably by Chinese traders, hundreds of years ago. It is a good source of vitamins A, B, and C. The perennial demand for it in the market and on the family table makes it one of the most important vegetables grown in Chinese gardens in the vicinity of large cities like Manila and in school and home gardens in many parts of the Philippines.

VARIETIES AND YIELD

The varieties of pechay are not standardized. There is confusion over the botanical identities of Chinese cabbage, Chinese mustard, Indian mustard, and other closely related forms. Some believe that it is impossible to determine the species to which some of these plants belong, as most seed stocks show considerable variation among the plants. However, there are two types of pechay known and grown in the Philippine: the heading type or Pe-tsai; and the loose, open type called Pak-choi, which has been erroneously called "white mustard." Of the heading type, Wong-Bok and Chihili have been successfully grown in Trinidad Valley, Mountain Province, and in other places with higher altitude and cooler climate.

The Bureau of Plant Industry reports that Wong-Bok and Chihili yield about 9,992 kilograms and 9,397 kilograms of heads a hectare, respectively. The common Chinese pechay of the loose, open type is described as having light to dark-green leaves, wavy margins to smooth leaves, and narrow to broad, white, fleshy petioles. This type yields about 10,000 kilograms to the hectare.

In the horticulture projects of the U. P. Rural High School, the common Chinese variety originally obtained from the Department of

¹ Central Experiment Station Contribution No. 1675.

Agriculture and Natural Resources has been grown from year to year by freshmen boys. From the lot of one-fourth hectare devoted to this crop, 32,160 heads, or 5,259 kilograms, were produced in one harvest season.

FACTORS INFLUENCING PECHAY PRODUCTION

Three factors influence the production of pechay: soil, moisture, and temperature.

Soil. Pechay is not selective about its soil requirements; it grows in a wide range of soils. The production of a good quality crop, however, requires soil that is deep, fertile, rich in organic matter, and well-drained.

Moisture. Pechay, like other leafy vegetables, grows well in soil that is supplied constantly with sufficient moisture during its entire growth. In places where irrigation water is available throughout the year, more than one crop is possible. Heavy rains, however, are detrimental to the plants, especially when they are still small. The planting time, therefore, should be adjusted to avoid adverse weather conditions.

Temperature. The best crop of pechay is produced during the cooler part of the year. A high quality crop which commands a better price is produced with less effort and expense. Temperature is most frequently the limiting factor.

STARTING THE SEEDLINGS

In the horticulture projects of the U. P. Rural High School, the pechay seeds were first grown in two seedbeds, each 1 meter wide and 5 meters long. The beds were adjacent to the field and near a water supply. They were dug deep and made smooth and level, firm and compact beneath, loose and open on the surface, and free from clods and weeds. The soil, which was of moderate fertility, was sterilized by "firing." The seedbeds were prepared in November.

Germinating the seeds. The seeds were broadcast thinly and evenly on the seedbeds and then covered with well-pulverized and sterilized soil. The amount of seeds needed to plant the 2,500-square-meter lot was 250 grams, or about a kilogram to the hectare. The seeds germinated in two days. Before the seeds germinated, the seedbeds were sprayed with foliafume after each watering to keep the ants from stealing or injuring the seeds. The spray was prepared by dissolving 10 cc. of foliafume in every 3 liters of water.

Caring for the seedlings The pechay seedlings were sprinkled evenly with just enough water to soak the soil. This was done twice daily, in the morning and in the afternoon, especially when the weather was hot. Overwatering was avoided because it resulted in succulent, slender growths which were hard to correct.

The seedlings were given two applications of fertilizer at intervals of three to four days to hasten their growth and make them

vigorous. Ammonium sulfate was applied in solution at the rate of 10 grams to every 10 liters of water. The seedlings were watered again to prevent the burning effect of the fertilizer on the plants.

To prepare the seedlings for conditions in the open field, they were not watered two days before transplanting.

PREPARING THE FIELD AND TRANSPLANTING THE SEEDLINGS

Plowing. The field was plowed twice with a tractor with a two-moldboard attachment early in November just after the seeds had been sown in the seedbeds.

Harrowing. A four-gang disk harrow was used to harrow the field three days after each plowing. Two additional harrowings were made to check weed growth and to pulverize the soil more thoroughly.

Plotting. The field was plotted with a tractor with a one-moldboard attachment. The plots were pulverized again with garden hoes and rakes. Each plot was 1 meter wide and 5 meters long.

Transplanting. The pechay seedlings were transplanted 20 days after the date of seeding, or when they had two to three pairs of true leaves and were about 8 centimeters in height. Before the seedlings were removed from the seedbeds, they were watered lightly to minimize the ill effects of the destruction of roots. They were lifted with a spatulate piece of stick and carried to the field in banana leaf sheaths of convenient size.

The seedlings were planted in the plots at distances of 20 centimeters each way (fig. 1). In each plot 96 seedlings were planted, or about 32,160 transplants in the 2,500-square-meter lot. In transplanting, a hole large enough to allow plenty of room for the roots was made in the soil with the forefinger. A seedling was set in the hole at a depth of about two and one-half centimeters, or at the level of the first pair of leaves. The base was then slightly firmed.

Cool, cloudy weather, just before or after a rain, was best for transplanting. When the weather was hot, the transplants were shaded with banana leaf sheaths.

CULTIVATING AND WEEDING

Cultivation is important in vegetable culture because it gets rid of weeds and stimulates growth by loosening the soil around the plants. Cultivation and weeding were started soon after the plants had shown signs of new growth and were continued thereafter whenever necessary. Pulverizing and hilling the soil with a hand trowel or a similar tool around the base of each plant also prevented the plant from inclining. Shallow cultivation was preferred to deep cultivation, although the first cultivation was deep so as to loosen the soil that had been compacted during transplanting.

WATERING

As pechay demands a continuous, ample supply of water, the plants were watered twice a day, once in the morning and again in the afternoon, especially during dry days.



Fig. 1.—The right size of the seedlings for transplanting.

FERTILIZING

Pechay is very responsive to fertilizer. Being a leafy crop, it is a heavy feeder, requiring fertilizer rich in nitrogen. Ammonium sulfate was applied at the rate of 5 grams to a plant, or 3.5 bags of 45.45 kilograms a bag to the lot of one-fourth hectare. This fertilizer was applied in two installments. It was first applied at the time of the first cultivation; a ring as wide as the spread of the leaves was made around the base of each plant and the fertilizer was evenly distributed there and covered slightly. The second application was made four days after the first application.

PESTS AND DISEASES

No serious pest or disease attacked the crop. This may be attributed to the clean culture method of growing the crop and to the timeliness of planting.



Fig. 2. Upper panel—The vigorous growth of Chinese pechay and distance of setting. The plants are 21 days old. Lower panel—The size of a 21-day-old plant.

HARVESTING AND PREPARING THE PRODUCT
FOR THE MARKET

The crop was harvested promptly. Pechay, being a fast growing crop, loses its tenderness and palatability if it is allowed to remain long in the field. Plants of adequate size were harvested when they

had six to eight expanded leaves, or 21 days after the date of transplanting (fig. 2, upper and lower panels). They were harvested either early in the morning or in the afternoon, depending upon the nearness of the market and the method of packing used. They were either uprooted and the soil washed off or cut level to the ground.

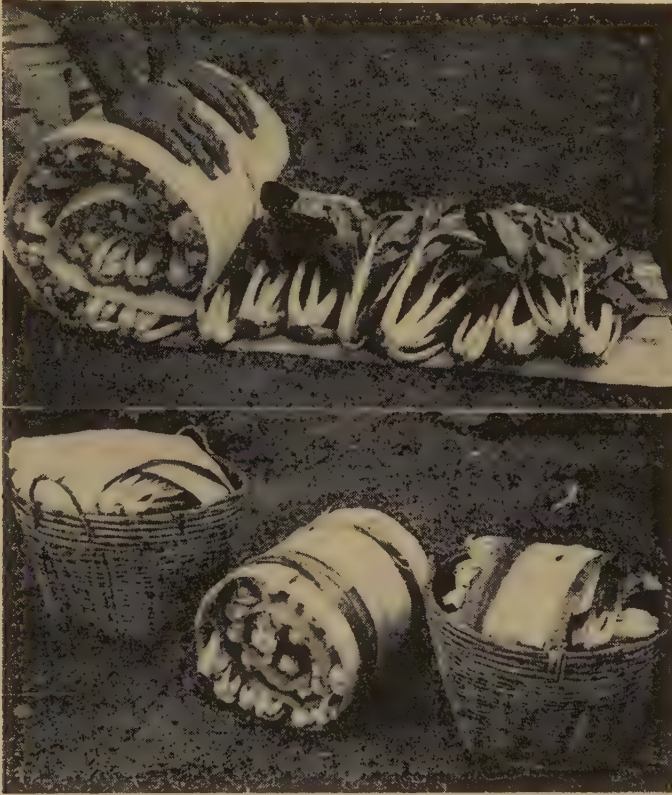


Fig. 3. Upper panel—Rolling the mat with the pechay plants.
Lower panel—Two ways of packing pechay.

The products were packed carefully for the market in a large bamboo basket called "kaing" (fig. 3, lower panel). An average-sized "kaing" may contain about 50 plants, or about 8 to 10 kilos. In the absence of a "kaing," a banana leaf sheath was used for packing the pechay. The thick back of each leaf sheath was removed with a bolo for greater ease in rolling. Two leaf sheaths of convenient length were spread out side by side with the backs up. The pechay plants were laid side by side on the whole length of the mat (fig. 3, upper panel) with the butts of the plants pointing toward the margin and all the leaves towards the middle. The mat was then rolled carefully. Another piece of leaf sheath about as wide as the

mat was placed at the end of the roll to keep it from splitting when tied securely. A good-sized pack contained 50 plants of about 8 to 10 kilograms, fresh weight.

A garden plot 5 meters long and 1 meter wide easily produces about P4.50 worth of fresh, tender, succulent pechay at 30 centavos a kilogram. At times, pechay may sell for as high as 50 to 80 centavos a kilogram.

THE ECONOMIC AND SOCIAL CONDITIONS OF COCONUT FARMERS IN DESPUJOLS, ROMBLON¹

FRANCISCO M. SACAY AND BLAS A. GAAC

In Despujols, Romblon, from 1948 to 1949, the average area of a farm was 3.4 hectares, and the average investment was ₱3,963.08. About 96.9 per cent of the farm area was devoted to crops. Coconut was the principal crop grown and the main source of income. The farm receipts averaged ₱1,873.53, of which 87.1 per cent came from coconut. The average farm expenses amounted to ₱693.88, of which 48.7 per cent was the harvesters' share. The labor income averaged ₱931.97; labor earnings, ₱1,389.07; family income, ₱1,570.42; amount available for family living, ₱1,818.10, or an average of ₱330.56 for each member.

The average household had 5.5 members. Most of the houses had nipa roofs, nipa walls, and wooden and bamboo floors. The facilities and conveniences in farm homes were inadequate.

The children 7 to 14 years old who were out of school had completed an average of 2.1 grades. With the exception of the Bible and church hymnals, there was little reading matter in the homes.

As the coconut farmers of Despujols have small farms and insufficient incomes, it is necessary that they be taught better methods of farming to increase their incomes and raise their standard of living.

There is considerable interest at present in the improvement of the economic and social conditions of farmers in our barrios. Several government agencies are now engaged in this work. In planning programs for improvement, adequate knowledge of existing conditions should first be secured; hence, this investigation was conducted.

Although several studies have been made on the economic and social conditions of other types of farmers, very little work has been done on coconut farmers, particularly in recent years. Hester and Miniano² studied the economic aspects of coconut tenants in the municipality of Looc in Romblon. They found that the average tenancy holding was 2.17 hectares and that about 30 per cent of the products went to the tenants.

The investigation reported in this paper was made for the purpose of studying (1) the economic conditions of coconut farmers, such as their type of farming, size of farm, crops grown, livestock raised, and income, and (2) their social conditions, such as the nature of their dwelling, their household conveniences, educational attainment, and recreational activities. The field work was done in 1949 in the municipality of Despujols, Romblon. The survey included 120 coconut farmers, all of whom were owner-operators. The data were

¹ Central Experiment Station Contribution No. 1676.

² HESTER, EVETT D., AND GERONIMO MINIANO. 1921. Tenancy on coconut holdings in the municipality of Looc, Romblon. *Philippine Agriculturist* 10: 145-168.

obtained through personal interviews with the farmers, their wives, and older children. A schedule was used in recording the data. The data concerning the farm business covered the crop year 1948-49.

The area studied is in a coconut-producing district. The municipality maintains a complete elementary school in the poblacion and a primary school in each barrio. Secondary education is available in the town of Odiongan, 19 kilometers away. Junior colleges are found in this town and in large neighboring islands.

FINDINGS AND DISCUSSION

Age and farming experience of operators. The farm operators ranged in age from 20 to 64 years, or an average of 36.1 years. About 80 per cent were born in the barrio where they were residing at the time of survey; 4.2 per cent were born in other barrios of the town. The operators had resided in the municipality for an average of 29.8 years. They had been farming from 1 to 48 years, or an average of 12.4 years.

Size and utilization of farm area. The farms ranged in area from 0.9 hectare to 20.9 hectares, or an average of 3.4 hectares (table 1). About 96.9 per cent of the farm area was planted to crops.

Capital investment. The capital investment in a farm was, on the average, ₱3,963.08, of which 72.2 per cent was in land. Only small amounts were invested in livestock and tools.

Crops grown and livestock raised. Coconut was the principal crop grown by the farmers. The other crops raised and the area devoted to each are given in table 1.

The carabao, the animal used for work, was found on all farms. Some farms raised other livestock. The types of livestock raised and the average number to a farm are also shown in table 1.

Farm receipts and expenses. The principal source of income was the coconut, which contributed 87.1 per cent to the receipts from crops. Fruits and vegetables contributed about 10 per cent. The receipts from a farm averaged ₱1,873.53.

The most important item of expense was the harvesters' share, which amounted to 48.7 per cent. Cash expenses amounted to 29.3 per cent. The farm expenses averaged ₱693.88.

Labor income and labor earnings. The labor income for each farm averaged ₱931.97. The farm privileges amounted to ₱457.10, of which 71.8 per cent were crop products. The operator's labor earnings averaged ₱1,389.07. There was a tendency for labor earnings to increase as the crop area and the area planted to coconuts increased.

Family income. The operator, as well as the other members of the family, had income from other sources (table 1). The total amount available for family living was ₱1,818.10, or ₱330.56 for each member of the household.

Type and composition of households. The most common household was the husband-wife-two children type, which comprised 23.4 per cent. The other types of households and the number of each type may be seen in table 2.

There was an average of 5.5 persons in each household. Of this number, 62.1 per cent were children. About 1.7 per cent of the members of the household were relatives.

Type and size of dwellings. Most of the houses had nipa roofs. Only 4.1 per cent had G.I. roofing. The most common dwelling had nipa walls and bamboo and wooden floors. The more common types of dwellings and the number of houses of each type are shown in table 2.

The floor area of a dwelling averaged 52.9 square meters, or 9.6 square meters to a person. The average number of rooms to a dwelling was 2.1.

Home facilities and conveniences. The common conveniences in the homes of the farmers were bamboo chairs, wooden benches, wooden chairs, wooden beds, and dining tables. The other facilities and the number of homes with such facilities are given in table 2.

Attempts were made by some of the residents to beautify their homes. About 22.5 per cent had potted plants in the house, 20 per cent had climbing plants around the house, and 14.1 per cent had potted plants in the yard.

School attendance and educational attainment. Of the children 7 to 14 years old, about 78 per cent were in school. The average grade completed by those who were out of school was 2.1.

Reading matter in farm homes. The most common reading matter was the Bible and church hymnals (table 2). Although 15 other kinds of books, magazines, and newspapers were found, only a few homes had at least one of these. About 12 per cent had no reading matter of any kind.

Recreational activities. Cockfighting, card playing, swimming, hunting, and carabao racing were the common recreational activities of the farmers. Among the wives, the most common were chatting and reading religious books. Children played or watched ball games and went swimming, boating, or fishing.

TABLE 1

Farm conditions of coconut farmers in Despujols, Romblon, 1948 to 1949

	NUMBER OF FARMS INVOLVED	AVERAGE OF ALL FARMS	PERCENTAGE
Size of farms, hectares:			
Below 1	120	3.4	4.2
1-1.9	5		22.5
2-2.9	27		25.7
3-3.9	31		10.8
4-4.9	13		11.7
5-5.9	14		8.3
6 and over	10		17.8
Capital investment in a farm, pesos	20	3,963.08	
Important crops planted and area in hectares:			
Coconut	120	2.8	
Cassava-rice	46	0.3	
Mungo	19	0.2	
Rice	34	0.6	
Sweet potato	38	0.2	
Common farm animals:			
Carabao	120	1.4	
Cattle	29	0.5	
Horse	21	0.3	
Pig	50	1.6	
Chicken	36	6.3	
Receipts from principal crops, pesos:			
Coconut		1,605.51	87.1
Mungo		35.22	1.9
Sweet potato		14.32	0.5
Fruits and vegetables		178.13	10.0
Farm receipts from a farm, pesos		1,873.53	
Farm expenses of a farm, pesos		693.88	
Net farm income, pesos		1,179.65	
		831.97	
Farm privileges, pesos		457.10	
Operator's labor earnings, pesos		1,389.07	
Family income, pesos		1,570.42	
Operator's labor earnings		1,389.07	88.5
Operator's income from job off farm ...		78.96	5.0
Unpaid family labor		96.39	6.2
Income of other members from job off farm		6.00	0.3
Amount available for family living, pesos ...		1,818.10	
Amount available for each member of the household, pesos		330.56	

TABLE 2

Home conditions of coconut farmers in Despujols, Romblon, 1948 to 1949

	NUMBER	PERCENTAGE
Individuals in a household	5.5	
Common types of households:		
Husband-wife-2 children	28	23.4
Husband-wife-3 children	23	19.2
Husband-wife-4 children	16	13.4
Husband-wife-5 children	16	13.4
Grade completed by out-of-school children 7-14		
years old	2.1	
Dwellings with galvanized iron roof	5	4.1
Dwellings with nipa roof, wooden walls, wooden floor	10	8.3
Dwellings with nipa roof, nipa walls, bamboo floor	44	37.0
Floor area of a dwelling, square meters	52.9	
Rooms in a dwelling	2.1	
Persons to a room	2.6	
Dwellings with home conveniences:		
Sewing machine	34	28.3
Iron bed	24	20.0
Wooden bed	74	64.2
Bamboo bed	84	70.0
Bicycle	6	5.0
Bamboo chair	120	100.0
Clock	34	28.3
Dining table	78	65.0
Flatiron	112	93.3
Ground well	40	33.3
Wooden bench	120	100.0
Wooden chair	120	100.0
Homes with books and current literature:		
Holy Bible	80	77.7
Church hymnals	27	22.5
Manila Times	7	5.8
Philippines Free Press	14	11.6
Bulaklak	7	5.8
Without any current literature	14	11.6

THE PROGRESSION IN WEIGHT OF NATIVE RABBIT SUCKLINGS ¹

VALENTE VILLEGAS

WITH ONE TEXT FIGURE

There was no difference in weight between the common rabbit sucklings of both sexes at different ages. The mean birth weight was 60 grams. At the age of eight days, the birth weight was practically doubled; at 14 days, trebled; at 21 days, quadrupled; at 25 days, sextupled; and at 31 days, or at the end of the suckling period, the weight was approximately 6.6 times that of the birth weight.

The rabbit is becoming a popular animal in the Philippines. It can be raised on a large scale for its meat which compares favorably with chicken meat. Laboratories also use rabbits for various scientific experiments and tests.

The object of this paper is to present the progression in weight of native ² rabbit sucklings from birth until the end of the suckling period. The work was conducted in the Department of Animal Husbandry from December 14, 1948, to April 27, 1949.

Twelve male and thirteen female sucklings were used. All of them were white, except A6, A7, and B6 which were black. Rabbits of this native strain come in white, gray, brown, and black, the white rabbits being more popular. Rabbits A3 to A7, A10 to A12, B4 to B6, and B9 to B12 belonged to litters of five young each; A1, A2, and B1 to B3, to litters of six young each; and A8, A9, B7, and B8, to litters of seven young each.

The animals were weighed daily in the afternoon between three and four o'clock on a Sargent balance accurate to one gram. During the period of investigation of 31 days for each suckling, the animals fed largely on the milk of their dams. Observations made on five litters showed that rabbit sucklings start to take soilage when they are from 14 to 24 days, or at an average age of 19 days, and concentrates when they are from 19 to 28 days, or at an average age of 23.4 days.

RESULTS

No significant and consistent difference in weight and increment at different ages was observed between sexes of rabbit sucklings under study; hence, data on 25 sucklings of both sexes are herein presented in consolidated form.

¹ Central Experiment Station No. 1677. Read before the Los Baños Biological Club on October 27, 1950.

² By native rabbit is meant a strain of rabbit which has been raised successfully in the Philippines for a long time.

Birth weight. The mean birth weight of the rabbit sucklings of both sexes was 60 grams, with a confidence interval between 57 and 63 grams (table 1). The range in weight was from 45 to 80 grams in the males and from 45 to 75 grams in the females.

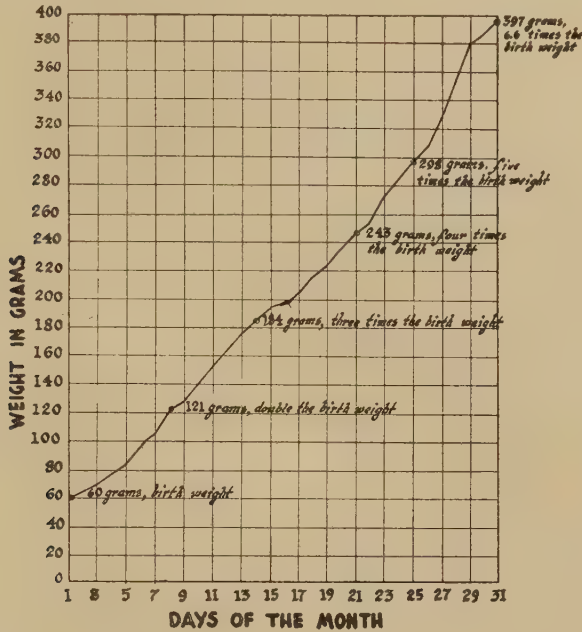


Fig. 1. The combined weight curve of common rabbit sucklings of both sexes.

Weights at different ages. Figure 1 and table 1 show that the mean weight of both sexes at eight days of age was 121 grams, or practically twice that at birth, the confidence interval being between 113 and 129 grams. The mean weight at 14 days of age was 184 grams, or over three times that at birth, and the confidence interval was between 170 and 198 grams. At the age of 21 days, the mean weight was 243 grams, or over four times the birth weight; the confidence interval was between 224 and 262 grams. On the 25th day after birth, the mean weight became more than six times the mean weight at birth; at this age, the mean weight was 298 grams, the confidence interval being between 279 and 317 grams. At 31 days of age, the end of the suckling period, the mean weight was over 6.6 times the birth weight, the mean weight being 397 grams and the confidence interval, from 373 to 421 grams.

TABLE 1

Combined mean weights and confidence intervals of male and female suckling rabbits

AGE IN DAYS	MEAN WEIGHT	95% CONFIDENCE INTERVAL	
		L 1	L 2
	<i>grams</i>	<i>grams</i>	<i>grams</i>
1	60	57	63
2	65	62	68
3	71	67	75
4	78	73	83
5	83	78	88
6	98	93	103
7	110	105	115
8	121	113	129
9	128	119	137
10	141	132	150
11	154	143	165
12	164	152	176
13	177	164	190
14	184	170	198
15	192	178	206
16	199	185	213
17	205	190	220
18	217	200	234
19	223	207	239
20	236	218	254
21	243	224	262
22	255	235	275
23	271	252	290
24	285	266	304
25	298	279	317
26	310	291	329
27	330	311	349
28	354	332	372
29	369	347	399
30	384	360	408
31	397	373	421

COLLEGE AND ALUMNI NOTES

Dr. Herbert K. Hayes, professor of plant breeding at the University of Minnesota, under the MSA contract between the U.P. College of Agriculture and Cornell University, was a campus visitor on September 3, 1952. He was accompanied by Dean L. E. Call. Dr. Hayes is one of the initial five agricultural experts who will teach at the College under the MSA technical assistance program. He and Mrs. Hayes will soon reside in one of the houses that are nearing completion on Faculty Hill.

Several groups of students in agricultural economics from various institutions in Manila visited the College recently. Rural pastors taking a course in rural economics under Prof. William A. Foster, Jr., of the Union Theological Seminary, had an educational trip to the College on September 6, 1952. They visited the different projects of the College as well as the private farm of Dr. V. C. Calma. Mr. Albino P. Varona, of the Department of Agricultural Economics, gave a lecture on farm management.

The agricultural economics class of FEU under Mr. Jose Q. Dacanay, '15, visited the College projects on September 7, 1952. Mr. A. P. Varona gave a lecture on farm management, and Dr. V. C. Calma, on horticulture.

The UE agricultural economics class under Dr. Shubert Yao, vice-head of the Department of Economics, was in the campus on September 13, 1952. Mr. N. B. Tablante gave a short lecture on rural cooperatives. Mr. C. Las Marias showed the visitors around.

Mr. Felix Franco, chief of the Division of Forest Investigation of the Bureau of Forestry, was guest speaker at an Arbor Day convocation at the Rural High School on September 12, 1952. The celebration also featured the planting of a narra tree by the class of 1953.

The junior class of the U. P. Rural High School had a Hawaiian Night dance on September 6, 1952. The president of the class is Melanio Domdom. The adviser is Miss Patrocinio V. Santos.

Mr. Chin Aroonrajna, of the Thai Sugar Organization, Ministry of Industry, was a campus visitor. He was accompanied by Mr. Alejandro Apacible, '34, formerly planters' chemist and agronomist of Central Don Pedro in Batangas.

A group of students, mostly seniors majoring in botany, zoology, or biology from U.P. Diliman, accompanied by Dr. G. T. Velasquez, head, Department of Botany, were guests of the Department of Agricultural Botany staff on September 28, 1952. Dr. J. M. Capinpin and Dr. J. R. Velasco gave lectures on genetic aspects of plant variants and phytohormones.

About 200 students of the Lady Mediatrix College, Candelaria, Quezon, visited the College last September 28, 1952. Miss F. O.

Fortich and Mr. B. Q. Ballesteros, of the Department of Agricultural Botany, gave lectures on various aspects of botany as offered in this College. The students were accompanied by Sor Bernardetta de Lourdes and Mr. Victoriano Gagolinan, a junior agronomist of the Bureau of Agricultural Extension.

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